NUCLEAR REGULATORY COMMISSION

10 CFR Parts 50 and 51

Waste Confidence Decision

AGENCY: Nuclear Regulatory Commission.

ACTION: Final Waste Confidence Decision.

SUMMARY: The Nuclear Regulatory Commission initiated a rulemaking proceeding on October 25, 1979 to assess generically the degree of assurance now available that radioactive waste can be safely disposed of, to determine when such disposal of off-site storage will be available, and to determine whether radioactive wastes can be safely stored on-site past the expiration of existing facility licenses until off-site disposal or storage is available. This proceeding became known as the "Waste Confidence Rulemaking" and was conducted partially in response to a remand by the U.S. Court of Appeals for the D.C. Circuit. *State of Minnesota* v. *NRC*, 602F 2d 412 (1979). The Commission also stated that in the event it determined that on-site storage of spent fuel would be necessary or appropriate after the expiration of facility licenses, it would propose a rule addressing the environmental and safety implications of such storage.

The Commission's decision is summarized in the following findings:

(1) The Commission finds reasonable assurance that safe disposal of high level radioactive waste and spent fuel in a mined geologic repository is technically feasible.

(2) The Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007–09, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high level radioactive waste and spent fuel originating in such reactor and generated up to that time.

(3) The Commission finds reasonable assurance that high-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all high-level radioactive waste and spent fuel.

(4) The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating licenses at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

(5) The Commission finds reasonable assurance that safe independent onsite or offset spent fuel storage will be made available if such storage capacity is needed.

In keeping with its commitment to issue a rule providing procedures for considering environmental effects of extended onsite storage of spent fuel in licensing proceedings, the Commission is issuing, elsewhere in this issue, final amendments to 10 CFR Parts 50 and 51.

FOR FURTHER INFORMATION CONTACT: Dennis Rathbun or Clyde Jupiter, Office of Policy Evaluation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone (202) 634–3295, or Sheldon Trubatch, Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555; telephone (202) 634–3224.

The Commission's Decision

In the Matter of RULEMAKING on the Storage and Disposal of Nuclear Waste (Waste Confidence Rulemaking)

[PR–50, –51 (44 FR 61372)]

August 22, 1984.

Contents

Decision

1.0 Introduction

1.1 Initiation of the Waste Confidence Rulemaking Proceeding

In response to the remand of the U.S. Court of Appeals for the District of Columbia Circuit (*State of Minnesota* v. NRC, 602 F.2d 412 (1979)), and as a continuation of previous proceedings conducted in this area by NRC (44 FR 61372), the Commission initiated a generic rulemaking proceeding on October 25, 1979. In its Notice of Proposed Rulemaking, the Commission stated that the "purpose of this proceeding is solely to assess generically the degree of assurance now available that radioactive waste can be safely disposed of, to determine when such disposal or off-site storage will be available, and to determine whether radioactive wastes can be safely stored on-site past the expiration of existing facility licenses until off-site disposal or storage is available." The Commission also stated that in the event it determined that on-site storage of spent fuel would be necessary or appropriate after the expiration of facility licenses, it would propose a rule addressing the environmental and safety implications of such storage. The Commission recognized that this generic proceeding would be broader than the Court's instruction, which required the Commission to address the questions of whether off-site storage for spent fuel would be available by the expiration of reactor operating licenses and if not, whether spent fuel could continue to be safely stored on-site (44 FR 61373).

However, the Commission believed that the primary public concern was whether nuclear waste could be disposed of safely rather than with an off-site solution to the storage problem per se. Moreover, as stated in the Federal Register Notice of October 25, 1979, the Commission committed itself to reassess its basis for reasonable assurance that methods of safe permanent disposal of high level waste would be available when they are needed. In conducting that reassessment, the Commission noted that it would "draw upon the record compiled in the Commission's recently concluded rulemaking on the environmental impacts of the nuclear fuel cycle (44 FR 45362–45374 [August 2, 1979])" (44 FR 61373).

The Department of Energy (DOE), as the lead agency on nuclear waste management filed its statement of position (PS) on April 15, 1980. Statements of position were filed by 30 participants by June 9, 1980, and were followed by cross statements (CS) from 21 of the participants by August 11, 1980.

1.2 Establishment of the Working Group

On May 28, 1980, the Commission directed the staff to form a Working Group to advise the Commission on the adequacy of the record to be compiled in this proceeding, to review the participants' submissions and identify issues in controversy and any areas in which additional information would be needed. The Working Group submitted a report to the Commission on January 29, 1981. The report summarized the record, identified key issues and controversies, and commented on the adequacy of the record for considering the key issues. The participants were invited to submit comments on the adequacy of the Working Group's summary of the record and its identification and description of the issues. Such comments were made by 20 participants by March 5, 1981.

1.3 Commission's Order for Oral Presentations

The Commission found additional limited proceedings to be useful to allow the participants to state their basic

positions directly to the Commissioners and to enable the Commissioners to discuss specific issues with them. In addition, the Commission invited comment on the following policy developments: (1) the Administration's announcement[1] of a policy favoring commercial reprocessing of spent fuel and instructing the Secretary of Energy to proceed swiftly toward deployment of a means of storing and disposing of commercial high-level radioactive waste, and (2) the submission of information to the Presiding Officer in this proceeding by DOE on March 27, 1981, concerning the DOE decision to "discontinue [its] efforts to provide federal government-owned or controlled away-from-reactor (AFR) [spent fuel] storage facilities." The participants were asked to comment on the significance to the proceeding of issues, particularly institutional concerns, resulting from these policy developments and to comment on the merits of DOE's new projection of spent fuel storage requirements and on the technical and practical feasibility of DOE's suggested alternative storage methods.

To implement the additional limited proceedings, the Commission consolidated the participants into the following identifiable groups: (a) federal government, (b) state and local participants, (c) industry, and (d) public interest groups (Second Prehearing Memorandum and Order, November 6, 1981). Prehearing statements (PHS) were provided by the consolidated groups, as well as by individual participants. The oral arguments were presented to the Commissioners on January 11, 1982.

The extensive record, comprised of all written and oral submissions provides the primary basis for the Commission's decision regarding the safe storage and disposal of spent fuel and nuclear waste. However, while the Commission was preparing this Waste Confidence decision, the Nuclear Waste Policy Act of 1982 (NWPA) was enacted. The Commission found that this Act had a significant bearing on the Commission's decision, and the Commission has considered the NWPA in reaching its conclusions. The Commission believes that the NWPA had its most significant impact in narrowing the uncertainties surrounding institutional issues. Moreover, although the NWPA is intrinsically incapable of resolving technical issues, it will establish the necessary programs, milestones, and funding mechanisms to enable their resolution in the years ahead.

[1] Presidential Nuclear Policy Statement, October 9, 1981.

The Commission's preliminary decision in the Waste Confidence proceeding was served on the consolidated participants on May 17, 1983. However, the parties to this proceeding had not yet had an opportunity to comment on what implications, if any, the NWPA had on the Commission's decision. Further, the Commission's discussion of the safety of dry storage of spent nuclear fuel, in its preliminary decision, relied substantially on material not yet in the record. Therefore, the preliminary decision was issued as a draft decision. The Commission requested the consolidated groupings of participants to comment on either or both of these issues. In addition, the Commission found that onsite storage after license expiration might be necessary or appropriate, and therefore, in accordance with its notice initiating this proceeding, it proposed a rule to establish how the environmental effects of extended onsite storage would be considered in licensing proceedings (48 FR 22730, May 20, 1983), as amendments to 10 CFR Parts 50 and 51.

Subsequently, in response to public comments on the proposed amendments to 10 CFR Part 51, the Commission reopend the comment period to address the environmental aspects of the fourth finding of the Commission's Waste Confidence decision, on which the proposed amendment to Part 51 is based (48 FR 50746, November 3, 1983). Public comments were requested on: (1) The environmental aspects of the fourth finding—that the Commission has reasonable assurance that, if necessary, spent fuel can be stored without significant environmental effects for at least 30 years beyond the expiration of reactor operating licenses at reactor spent fuel storage basins, or at either onsite or offsite independent spent fuel storage installations; (2) the determination that there are no significant non-radiological consequences which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses either at reactors or at independent spent fuel storage installations; and (3) the implications of comments on items (1) and (2) above for the proposed amendment to 10 CFR Part 51.

After reviewing these additional comments, the Commission found no reason to modify its fourth finding or the supporting determination.

The analysis of comments, together with the Commission's response is summarized in the Addendum to the Commission's decision.

The Commission notes that two relevant developments have occurred subsequent to the closing of the record in the Waste Confidence proceeding. They are the publication of DOE's draft Mission Plan for the Civilian Radioactive Waste Management Program (April, 1984) and the Commission's concurrence in DOE's General Guidelines for Recommendation of Sites for Nuclear Waste Repositories (July 3, 1984). These developments are a matter of public record, and in the case of the Commission's concurrence was the conclusion of a separate public proceeding. The Commission has considered the effects of these developments on its previously announced decision in this proceeding and determined that these developments do not substantially modify the Commission's previous conclusions.

The decision is summarized as five Commission findings in Section 2.0. The detailed rationale for these findings, including references to the record developed in this proceeding, is contained in the Appendix to this document. The Commission considers these five findings to be a response to the mandate of the U.S. Court of Appeals for the District of Columbia Circuit and, in addition, a generic determination that there is reasonable assurance that radioactive waste can and will be safely stored and disposed of in a timely manner.

In keeping with its commitment to issue a rule providing procedures for considering environmental effects of extended onsite storage of spent fuel in licensing proceedings, final amendments to 10 CFR Parts 50 and 51 are being issued simultaneously with this decision.

2.0 Commission Findings [2]

(1) The Commission finds reasonable assurance that safe disposal of high level radioactive waste and spent fuel in a mined geologic repository is technically feasible.

(2) The Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent

[2] All findings by the Commission in this proceeding are limited to the storage and disposal of high-level radioactive waste and spent fuel generated by nuclear power reactors required to be licensed under sections 103 or 104 b of the Atomic Energy Act of 1954 (42 U.S.C. 2133 and 2134(b)), and to facilities intended for such storage or disposal. The Commission's findings in this proceeding do not address the storage and disposal of high-level radioactive waste or spent fuel resulting from atomic energy defense activities, research and development activities of the Department of Energy, or both. This is consistent with the Nuclear Waste Policy Act of 1982, section 8(c).

fuel will be available by the years 2007–09, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high level radioactive waste and spent fuel originating in such reactor and generated up to that time.

(3) The Commission finds reasonable assurance that high-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all high-level radioactive waste and spent fuel.

(4) The Commission finds reasonable assurance, that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

(5) The Commission finds reasonable assurance that safe independent onsite or offsite spent fuel storage will be made available if such storage capacity is needed.

3.0 Future Actions by the Commission

The Commission's Waste Confidence decision is unavoidably in the nature of a prediction. While the Commission believes for the reasons set out in the decision that it can, with reasonable assurance, reach favorable conclusions of confidence, the Commission recognizes that the possibility of significant unexpected events remains open. Consequently, the Commission will review its conclusions on waste confidence should significant and pertinent unexpected events occur, or at least every 5 years until a repository for high-level radioactive waste and spent fuel is available.

.0 For Further Information Contact

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Dated at Washington, D.C. this 22nd day of August, 1984. Commissioner Zech did not participate in this action.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,

Secretary of the Commission.

Addendum to the Commission's Waste Confidence Decision

Introduction

On May 17, 1983, the Commission issued its proposed decision in the Waste Confidence proceeding, and asked the consolidated groups of participants to comment on two aspects of the decision: the implications of the Nuclear Waste Policy Act (NWPA) for the decision and the Commission's discussion of the safety of dry storage of spent nuclear fuel, which relied substantially on material not in the record. The analysis of these comments is subdivided into several issue categories and presented, with NRC's responses, in Part I below. The membership of the consolidated groups responding to the Commission's request as well as the abbreviations used to identify the groups are provided in Section 3 of Part I.

Subsequently, in response to public comments on the Commission's proposed amendment to 10 CFR Part 51 (48 FR 22730, May 20, 1983), the Commission reopened (48 FR 50746, November 3, 1983) the comment period to address the environmental aspects of the fourth finding of the Commission's proposed Waste Confidence decision on which the proposed amendment to Part 51 is based. Public comments were requested on: (1) The environmental aspects of the fourth finding—that the Commission has reasonable assurance that, if necessary, spent fuel can be stored without significant environmental effects for at least 30 years beyond the expiration of reactor operating licenses at reactor spent fuel storage basins, or at either onsite or offsite independent spent fuel storage installations; (2) the determination that there are no significant non-radiological consequences which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses either at reactors or at independent spent fuel storage installations; and (3) the implications of comments on items (1) and (2) above for the proposed amendment to 10 CFR Part 51. The analysis of public comments and NRC's responses are presented in Part II of this document. The list of respondents to this reopened comment period and the abbreviations used to identify them are given in Section 4 of Part II.

The Commission notes that two relevant developments have occurred subsequent to the closing of the record in the Waste Confidence proceeding. They are the publication of DOE's draft Mission Plan of the Civilian Radioactive Waste Management Program (April, 1984) and the Commission's concurrence in DOE's General Guidelines for Recommendation of Sites for Nuclear Waste Repositories (July 3, 1984). These developments are a matter of public record, and in the case of the Commission's concurrence was the conclusion of a separate public proceeding. The Commission has considered the effects of these developments on its previously announced decision in this proceeding and determined that these developments do not substantially modify the Commission's previous conclusions.

Part I. Analysis of the Consolidated Groups' Comments on the Commission's Waste Confidence Decision and NRC Responses

1. Effect of the Nuclear Waste Policy Act on the Commission's Decision

A. General

(1) *Summary of Comments.* The Consolidated Industry Group agreed with the Commission's view that the NWPA contains provisions pertinent to all of the major elements relevant to mined geologic disposal of high level radioactive wastes (Industry, p. 3). The Industry Group called attention to the comprehensive nature of the NWPA which authorizes DOE to undertake steps leading to the construction, operation and maintenance of a deep geologic test and evaluation facility; requires DOE to prepare a waste management mission plan; establishes a prescribed schedule for repository siting, construction and operation; defines the decision-making roles of affected states and Indian tribes in repository site-selection and evaluation; provides for the continuity of Federal management of the nuclear waste program and continued funding; and facilitates the establishment of an overall integrated spent fuel and waste management system. The Industry Group suggested that these features of the Act should increase the Commission's confidence that waste can and will be disposed of safely. The Group pointed out that the Act also contains special procedures to facilitate the licensing of spent fuel storage capacity expansion and transshipments; directs DOE research, development and cooperation with utilities in developing dry storage and rod compaction; and provides for federally supplied interim storage capacity to supplement that of industry (Industry. pp. 4–8).

The Industry Group believed that the NWPA's enactment—in and of itself—provides a sound basis for confidence that institutional difficulties can and will continue to be resolved. At the same time, Industry stated that the NWPA's enactment was not essential for the Commission to reach an affirmative decision in this proceeding (Industry, p. 9).

In contrast, the Consolidated Public Interest Group (CPIG) believed that the NWPA provides an insufficient basis for the Commission's decision in this proceeding with respect to the availability or timing of a nuclear waste repository. The CPIG contended that the NWPA contains many areas of ambiguity, and gave as examples:

(i) Section 114(a) of the NWPA requires DOE to make a recommendation to the President for the first repository site, accompanied by the preliminary comments by the Commission concerning the suitability of three alternative candidate sites for licensing under 10 CFR Part 60. DOE interprets this section to require such preliminary comments *before* site characterization begins * * * The Commission staff interprets that section * * * to require a judgment of suitability under 10 CFR Part 60 *after* site characterization has occurred.

(ii) DOE originally interpreted Sec. 112(f) to permit continuation of ongoing site characterization at Hanford before completion of the DOE siting guidelines. DOE now concedes that such site characterization work must await completion of an environmental assessment prepared in accordance with final DOE siting guidelines (CPIG, pp. 2–3).

(2) *NRC Response.* The Commission has considered the effect of enactment of the Nuclear Waste Policy Act of 1982 and concludes that the Act provides support for timely resolution of technical uncertainties and reduces uncertainties in the institutional arrangements for the participation of affected states and Indian tribes in the siting and development of repositories and in the long-term management, direction and funding of the repository program. The bases for the Commission's conclusion are set forth in the decision and will not be repeated here. The passage of the Act provides evidence of a strong national commitment to the solution of the radioactive waste management problem.

The Commission recognizes the possibility of differing interpretations regarding the implementation of the NWPA. With respect to CPIG's discussion of Section 114(a), the Commission is unaware of any differences between DOE and NRC in the interpretation of this section of the Act. We note that DOE's recommendation of a repository site to the President would necessarily be made after DOE's preliminary determination that three sites are suitable for development. DOE and NRC now agree that the preliminary determination of site suitability for the alternative sites should be made following site characterization (Commission's Final Decision on the U.S. Department of Energy's General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories [July 3, 1984]).

Concerning Section 112(f), DOE has continued site characterization at Hanford during formulation of the siting guidelines; in accordance with the views of the states and environmental groups, DOE has deferred drilling of the exploratory shaft pending the completion of the guidelines, submission of the site characterization plan to NRC and preparation of an environmental assessment of site characterization activities.

B. Technical Aspects

(1) *Summary of Comments.* The Consolidated Industry Group believed that the Act contained provisions pertinent to all of the major elements relevant to disposal (Industry, p. 3). The Consolidated Public Interest Group, on the other hand, contended that the NWPA did not resolve technical uncertainties concerning repository development and safety (CPIG, p. 5). The Consolidated State Group did not believe that the NWPA supported a finding of confidence because it failed to resolve technical questions and merely set target dates for deciding on the site of the first waste repository. The State Group noted that if technical problems are not resolved by the dates proposed by Congress, the milestone dates will have to be postponed. The State Group contended too that, although the Act authorizes DOE to conduct research on unresolved technical issues, the research could uncover additional problems (States, p. 2). However, DOE pointed out that the NWPA provides for a focused, integrated and extensive research and development program for the deep geologic disposal of high-level waste and spent fuel. DOE believed that Sec. 215 of the Act enhances confidence in the timely availability of disposal facilities by authorizing a research facility to develop and demonstrate a program for waste disposal. DOE also stated that the schedule for a Test and Evaluation Facility would require the *in situ* testing described in Sec. 217 of the Act to begin not later than May 6, 1990, thus allowing for research and development results to be incorporated in the repository which is scheduled to open in 1998 (DOE, pp. 11, 12).

(2) *NRC Response.* As the record of this proceeding shows, there are no known technical problems that would make safe waste disposal impossible. Clearly, further engineering development and site-specific evaluations will be required before a repository can be constructed. The Commission did not propose to rely on the NWPA as the basis for resolving technical uncertainties. Rather, the Commission found that the NWPA provides a framework for facilitating the solution of the remaining technical issues. Title II of the Act authorizes DOE to undertake steps leading to the construction, operation and maintenance of a deep geologic test and evaluation facility and to conduct the necessary research and development as well as to establish a demonstration program. The schedule set forth in the Act is consistent with the objective of assuring repository operation within the time period discussed in the Waste Confidence decision. The "Mission Plan" which is required by the Act will provide an effective management tool for assuring that the many technical activities are properly coordinated and that results of research and development projects are available when needed.

C. Institutional Aspects

(1) *Summary of Comments.* The Consolidated State Group believed that the NWPA failed to resolve institutional questions. The States argued that their cooperation cannot be assumed in the event that the general public in the vicinity of a proposed site is opposed to the location. Further, the States contended that, if a site is vetoed by a host state or Indian tribe, there is no assurance that Congress will vote to override the veto. Moreover, if the veto is overridden, a legal challenge is likely and the outcome is uncertain (States, p. 3).

The Consolidated Public Interest Group also believed that the NWPA has not significantly reduced institutional uncertainties regarding participation and objections of affected states and Indian tribes. As examples of institutional difficulties, CPIG pointed out that state officials and Indian tribes still have concerns regarding the adequacy of time to monitor and comment upon agency proposals, the lack of agency response to their concerns, and inadequate funding to support their full participation. Further, CPIG noted that the Act (Sec. 115) provides states and Indian tribes with

strong new authority to veto the siting of a repository within their borders (CPIG, p. 5).

DOE, on the other hand, believed that Sections 116 and 117 of the NWPA will reduce Federal-state institutional uncertainties (DOE p. 9).

I(2) *NRC Response.* It would be unrealistic to expect that the NWPA will resolve all institutional issues. However, it does provide specific statutory procedures and arrangements for accomplishing such resolution. The right of affected states and Indian tribes to disapprove a site designation under the NWPA might create uncertainty in gaining the needed approvals. Nevertheless, the NWPA's establishment of a detailed process for state and tribal participation in the development of repositories and for the resolution of disputes should minimize the potential for substantial disruption of plans and schedules. The Commission does not expect that the NWPA can eliminate all disagreement about development of waste repositories. However, in providing for information exchange, financial and technical assistance to affected groups, and meaningful participation of affected states and tribes in the decision-making process, the Act should minimize the potential for direct confrontations and disputes.

D. Funding Aspects

(1) *Summary of Comments.* The Consolidated Industry Group expressed its general belief that the NWPA assures adequate funding for interim storage and disposal of radioactive waste (Industry, pp. 6, 7). Similarly, DOE believed that the funding mechanism provided by the NWPA should largely remove uncertainties in assuring adequate resources to complete the program (DOE, pp. 10, 11). On the other hand, the Consolidated States Group contended that, since the law can be changed at any time, the NWPA assures neither an adequate level of funding nor a prolonged Congressional commitment (States, p. 4).

(2) *NRC Response.* The Commission believes that the general approach prescribed by the NWPA is to operate DOE's radioactive waste program on a full cost recovery basis. It seems clear that Congress intended to establish a long-term program for waste management and disposal, with built-in reviews and adjustments of funding as necessary to meet changing requirements. In this regard, the Act provides that DOE must annually review the amount of the established fees to determine whether collection of the fees will provide sufficient revenues to offset the expected costs. In the event DOE determines that the revenues being collected are less than the amount needed to recover costs, DOE must propose to Congress an adjustment to the fees to ensure full cost recovery. The Act also provides that, if at any time, the monies available in the waste fund are insufficient to support DOE's nuclear waste program, DOE will have the authority to borrow from the Treasury. The Commission believes that long-term funding provisions of the Act will ensure adequate financial support for DOE's nuclear waste program for FY 1984 and beyond.

The Commission believes that uncertainties regarding the adequacy of financial management of the nuclear waste program have also been reduced by the NWPA requirement that an Office of Civilian Radioactive Waste Management be established within the Department of Energy. This Office is to be headed by a Director, appointed by the President with Senate confirmation, who will report directly to the Secretary of Energy. Further, the Act stipulates that an annual comprehensive report of the activities and expenditures of the Office will be submitted to Congress and that an annual audit of the Office will be conducted by the Comptroller General, who will report the results to Congress.

Some concern has been expressed that the Congress may amend the funding provisions of the NWPA and thereby undermine the financial stability of the Federal radioactive waste management program. Commenters have not provided any basis for this belief. The Commission considers this possibility to be most unlikely. It is reasonable to assume that the long-range public health and safety and political concerns which motivated the Congress over the past several years to pass the NWPA will continue to motivate the Congress in considering amendments to the NWPA.

E. Schedule

(1) *Summary of Comments.* DOE contended that the NWPA provides additional assurance that a repository will be available by 1998. As the basis for this belief, DOE stated that sections 111 through 125 of the NWPA provide specific schedules and reporting requirements for the timely siting, development, construction, and operation by 1998 of a repository for high level waste and spent fuel (DOE, p. 6). DOE believed that these schedules and reporting requirements will ensure that deadlines are met. The Commission notes that DOE recognizes that there has been a delay of about 1-year in its schedule for meeting early milestones such as publication of its siting guidelines; nevertheless, DOE continues to maintain that its date for completion of repository development will be met (DOE Draft Mission Plan for the Civilan Radioactive Waste Management Program, April 1984).

The Consolidated Public Interest Group, however, did not believe that the provision of specific dates in the NWPA gives assurance that they will be met. CPIG cited, for example, the delay in preparing DOE's site selection guidelines, which were due by June 1983, and were expected to be delayed further (CPIG, p. 4).

Further, the CPIG contended that a date for the availability of a repository is not certain since both the President and the NRC have explicit authority to reject any or all site proposals that are submitted to them (CPIG, p. 4). Also, CPIG believed that the legislation contemplates the possibility of delay beyond satutory deadlines and NWPA's legislative history indicates that the timing of repository availability remains uncertain (CPIG, p. 5).

(2) *NRC Response.* One of the primary purposes of the NWPA is "to establish a schedule for the siting, construction, and operation of repositories that will provide reasonable assurance that the public and the environment will be adequately protected from the hazards posed by high-level radioactive waste and such spent nuclear fuel as may be disposed of in a repository." (Sec. 111(b)(1)). The Commission believes this purpose will be achieved.

As the Commission noted in the proposed decision, the Congress would not be able to legislate the schedules for the accomplishment of fundamental technical breakthroughs if it believed that such breakthroughs were necessary. They are not necessary. Rather, it is the Commission's judgment that the remaining uncertainties can be resolved by the planned step-by-step evaluation and development based on ongoing site studies and research programs. The Commission believes the Act provides means for resolution of those institutional and technical issues most likely to delay repository development, both because it provides an assured source of funding and other significant institutional arrangements, and because it provides detailed procedures for maintaining progress, coordinating activities and rectifying weaknesses.

The Commmission believes that the milestones established by the Act are generally consistent with the schedules presented by DOE in the Waste

Confidence proceeding and that those milestones are generally reasonable. Achievement of the scheduled first date of repository operation is further supported by other provisions of the Act which specify means for resolution of issues most likely to delay repository completion. One of the earlier milestones-publication of DOE's general guidelines for the recommendation of sites for a repository—was about a year behind schedule and the Commission was concerned that his delay could result in corresponding delays in DOE's nomination of at least five sites for characterization work. However, DOE has indicated in its draft Mission Plan (April, 1984) that the subsequent milestones have been scheduled to provide completion of the first repository by 1998. The Commission believes that the timely attainment of a repository does not require DOE's program schedule to adhere strictly to the milestones set out in the NWPA over the approximately 15 year duration of the repository development program. Delays in some milestones as well as advances in others can be expected.

The Commission has no evidence that delays of a year or so in meeting any of the milestones set forth in the NWPA would delay the repository availability date by more than a few years beyond the 1998 date specified in the NWPA. The Commission found reasonable assurance that a repository would be available by 2007–09, a decade later than that specified in the NWPA, and a date which allows for considerable slippage in the DOE schedule. The Act also requires that any Federal agency that determines that it cannot comply with the repository development schedule in the Act must notify both the Secretary of Energy and Congress, provide reasons for its inability to meet the deadlines, and submit recommendations for mitigating the delay. The Commission notes that the Act also clarifies how the requirements of the National Environmental Policy Act are to be met. These provisions of the Act, as well as the provisions for research, development and demonstration efforts regarding waste disposal, increase the prospects for having the first respository in operation not later than the first few years of the next century.

The repository development schedule may have to accommodate such contingencies as vetoes of proposed repository sites, prolonged public hearings, protracted litigation, possible project reorientation, or delay in promulgation of siting guidelines. The schedule now incorporated into the Act allows substantial time for these possibilities.

2. Discussion of the Safety of Dry Storage

A. Summary of Comments

DOE believed that the availability of dry storage techniques provides further reasonable assurance of the ability to safely store nuclear wastes at least 30 years beyond the expiration of reactor operating licenses. DOE stated that the citations quoted in the Commission's rationale are reliable and representative of the literature in the area, and that the Commission's technical judgment on dry storage conforms with DOE's experience and is accurate and correct (DOE, p. 16). The Consolidated Industry Group also stated that the pertinent points in the Commission's discussion appear to be adequately supported with appropriate references (Industry, pp. 10, 11).

In further support of the safety of dry storage, DOE cited the following:

—Extensive world-wide experience shows that dry fuel handling and storage is safe and efficient. Irradiated fuel has been handled, shipped, and safely stored under dry conditions since the mid-1940's. All types of irradiated fuel have been handled dry at hot cells, where a variety of phenomena have been observed in detail. The passive nature of most dry storage concepts contributes to the safety of interim storage by not requiring active cooling systems involving moving parts (DOE, p. 16).

—Regarding specific experience, DOE stated that a reactor fuel has been successfully stored in dry vaults licensed under Part 50 at the Hallam sodium-cooled graphite research reactor in Nebraska and the Fort St. Vrain HTGR prototype facility in Colorado. In addition, dry storage of zircaloy-clad fuel has been successfully conducted in drywells and in air-cooled vaults at DOE's Nevada Test Site. There is favorable foreign experience with dry storage at Wylfa, Wales in Great Britain, at Whitesell in Canada, in the Federal Republic of Germany, in France where vault dry storage of vitrified waste is routine, and in Japan, where a dry storage vault has been recently constructed (DOE, p. 17).

—To date, all dry storage tests have indicated satisfactory storage of zircaloy-clad fuel without cladding failure over the temperature range of 100 degrees C to 570 degrees C, in inert atmospheres. Existing data which support the conclusion that spent fuel can be stored safely in an inert atmosphere for at least 30 years is being augmented by additional ongoing research (DOE, pp. 17, 18).

None of the consolidated groups of participants offered comments which were critical of the Commission's discussion of the safety of dry storage.

B. NRC Response

The Commission is confident that dry storage installations can provide continued safe storage of spent fuel at reactor sites for at least 30 years after expiration of the reactor operating licenses.

3. List of Respondents

Consolidated Participants as Respondents to the Commission's Waste Confidence Decision

1. Department of Energy (DOE)
2. Consolidated States Representative [1] (States)
3. Consolidated Public Interest Representative [2] (CPIR)
4. Consolidated Industry Representative [3] (Industry)

PART II: Commission Consideration of Additional Comments on Its Fourth Finding

1. Introduction

On November 3, 1983, the Commission reopened the comment period in this proceeding to receive comments on: (1)

[1] The Consolidated States Group consists of the Attorney General of the State of New York, Minnesota (by its Attorney General and the Minnesota Pollution Control Agency), Ohio, South Carolina and Wisconsin. The remaining participants previously consolidated in the States Group have not joined in these comments.

[2] The Consolidated Public Interest Group is represented here by the Natural Resources Defense Council, Inc., the New England Coalition on Nuclear Pollution, the Sierra Club, the Environmental Coalition on Nuclear Power, Wisconsin's Environmental Decade, Mississippians Against Disposal, Safe Haven, Ltd., John O'Neill, Jr., and Marvin Lewis.

[3] The Consolidated Industry Group is represented by: American Institute of Chemical Engineers; American Nuclear Society; Association of Engineering Geologists; Atomic Industrial Forum; Bechtel National; Consumers Power; General Electric; Neighbors for the Environment; Scientists and Engineers for Secure Energy; Tennessee Valley Authority; the Utilities Group (Niagara Mohawk Power Corporation, Omaha Public Power District, Power Authority of the State of New York, and Public Service Company of Indiana, Inc.); and the Utility Nuclear Waste Management Group—Edison Electric Institute. In order to emphasize the independent nature of its participation, the American Nuclear Society has chosen to proceed separately. ANS continues to protest its assignment to the Consolidated Industry Group and has offered separate comments on the Commission's Waste Confidence decision. Since only the consolidated groups of participants were invited to comment on the proposed decision, the ANS's separate comments are not discussed here. Further, TVA, as a Federal agency, wishes to stress the independent nature of its paticipation.

The environmental aspects of its fourth finding—that it has reasonable assurance that, if necessary, spent fuel can be stored without significant environmental effects for at least 30 years beyond the expiration of reactor operating licenses at reactor spent fuel storage basins, or at either onsite or offsite independent spent fuel storage installations; (2) the determination that there are no significant non-radiological consequences which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses either at reactors or at independent spent fuel storage installations; and (3) implications of comments on items (1) and (2) above for the proposed amendment to 10 CFR Part 51 (48 FR 50746).

The Commission has considered those comments and, for the reasons discussed below, finds no reason to substantively modify its fourth finding or other related aspects of its decision in this proceeding. The Commission has, however, made revisions in its fourth finding to clarify its original intent.

Thirteen comments were received. Seven commenters identified various reasons which they believed argued against the finding.[4] Six commentors supported the finding.[5] In addition to the issues on which the Commission specifically requested comments, some commentors raised additional issues regarding the Commission's compliance with the National Environmental Policy Act (NEPA).

2. Environmental Aspects of Extended Storage of Spent Fuel

A. Radiological Consequences of Spent Fuel Storage

The Commission's proposed fourth finding stated:

> The Commission finds reasonable assurance that, if necessary, spent fuel can be stored safely without significant environmental effects for at least 30 years beyond the expiration of reactor operating licenses at reactor spent fuel storage basins, or at either onsite or offsite independent spent fuel storage installations.

The public was invited to submit additional comments on the environmental aspects of this finding. Those comments, and the Commission's responses to them, are set out below.

The State of Minnesota ("Minnesota"), through its Attorney General, and the Sierra Club believe that an event at the spent fuel pool for Prairie Island Nuclear Generating Station ("Prairie Island") indicates that irradiated spent fuel assemblies are degrading rapidly with time. In December 1981, during a fuel transfer operation at Prairie Island, the top nozzle assembly separated from the remainder of a spent fuel assembly due to stress corrosion cracking of the spent fuel assembly while it was in the spent fuel pool. Minnesota and the Sierra Club acknowledge that this separation was an isolated event; over 5,000 similar spent fuel assemblies have been moved successfully at other plants. These commentors also acknowledge that television examination showed no corrosion cracking of similarly designed fuel assemblies at other nuclear power plants: Zion, Trojan, Kewanee and Point Beach. They also acknowledge that even though the water contaminant contributing to stress corrosion cracking has never been identified, the possibility that it may have been sulfates has led the Commission to suggest that Prairie Island monitor the sulfate levels of its spent fuel pool.

However, the Sierra Club contended[6] that the NRC staff essentially ignored the opinion of Mr. Earl J. Brown, an NRC engineer, that sulfate contamination is a generic problem at Pressurized Water Reactors (PWRs). The Sierra Club also believes that television inspection of spent fuel assemblies in spent fuel pools cannot reveal the initial signs of stress corrosion cracking. For these reasons, the Sierra Club and Minnesota believe that there is no assurance that spent fuel can be stored safely in spent fuel pools for 30 years after reactor shut down or for 60 years after irradiation.

The NRC investigated the Prairie Island event and found it to be an isolated event without generic impact. The staff also concluded that if a fuel assembly were to drop due to top nozzle failures, such an event would not lead to a criticality hazard in a spent fuel pool and that such an accident would result in radiation levels at the site boundary well within the limits in 10 CFR Part 100. The NRC Staff Assessment Report ("SAR") and associated memoranda, although already publicly available in the Commission's Public Document Room, have been added to the docket of this proceeding. That SAR concluded that the event was caused by intergranular stress-corrosion cracking due to an unidentified corrodant temporarily present in the spent fuel pool.

As for the Sierra Club's specific comments, the staff recognized that sulfate contamination was suspected to have contributed to the corrosion and recommended that licensees administratively control sulfate level concentrations in spent fuel pools. Such monitoring had been recommended by Mr. Brown as the only action that should be taken in response to the incident. Although Mr. Brown stated that in his opinion the event was a "potential" generic issue for PWRs, subsequent staff investigation revealed that the event was an isolated incident. The staff also considered the properties of the steel used in the spent fuel assemblies and acknowledged that they could have contributed to the event. However, the absence of any similar events for 5,000 other spent fuel assemblies indicated that the type of steel was not critical. Accordingly, the Commission finds no basis for reconsidering the Safety Assessment Report's finding that the Prairie Island event was an isolated incident and recommendation that sulfate control was an adequate response, or for altering its conclusion concerning the potential environmental impacts of stored spent fuel.

Wisconsin, Safe Haven, Ltd. and NRDC contended that the environmental effects of extended spent fuel storage are site specific and should be considered on a case-by-case basis.[7] Safe Haven believes that the individuality of each plant and its environmental surroundings necessitate separate evaluations of extended storage of spent fuel, but identified no site-specific factors which would result in significant environmental impacts. NRDC listed some site specific factors: geology, hydrology, seismicity, ecological factors and individual proposals for spent fuel management and storage. However, NRDC did not suggest how these factors could lead to significant site-specific environmental impacts that would preclude the

[4] Department of Law of the State of New York, Maryin Lewis, Sierra Club, Safe Haven, Ltd., Attorney General of the State of Minnesota, Department of Justice of the State of Wisconsin and Natural Resources Defense Council, Inc.

[5] Scientists and Engineers for Secure Energy, Inc. American Institute of Chemical Engineers, American Nuclear Society, Utility Nuclear Waste Management Group—Edison Electric Institute, and U.S. Department of Energy.

[6] Sierra Club also stated that the staff did not consider an Oak Ridge report (ORNL 3684, Nov. 1964) which identified water vapor as contributing to corrosion of the type of steel used in spent fuel assemblies. That report is not germane to light water reactor fuel because it addressed the sensitization of stainless steel in a high temperature gas cooled reactor environment, which is very different from the environment of a light water reactor. Refer to the discussion in Sec. 2.4A of the Appendix to the Commission's decision.

[7] Safe Haven also suggested that a full environmental and safety review should accompany any utility's proposed plans submitted pursuant to 10 CFR 50 (§ 50.54(aa)) for extended storage of spent fuel. The Commission will treat its review of any such utility proposal in accordance with the established procedures for considering any application for a license amendment.

Commission from making a generic finding. Similarly, Wisconsin listed as relevant factors proximity to population centers, highways, geologic faults, dams, flood plains or shorelines affected by erosion, but offered no suggestion of how these factors could affect the Commission's generic determination. For example, there has been no discussion of why the Commission's seismic design requirements, though site specific, are not generically adequate to assure that spent fuel can be stored for up to 30 more years in a spent fuel pool designed to withstand the largest expected earthquake at each reactor site. Mr. Marvin Lewis contended that the fourth finding had no basis because the Commission had little or no experience with storing spent fuel for 30 years or with storing fuel that could be up to 70 years old. Mr. Lewis also asserted that the pyrophoricity of the zircaloy tubes containing spent fuel for 30 years presents and unknown fire danger. This comment is based on a private communication to Mr. Lewis regarding the condition of the spent fuel at Three Mile Island, Unit 2. By the terms of that letter, any fire danger associated with pyrophoricity of zircaloy arises from the accident conditions at TMI-2. NRC has previously studied the effects of loss of water from pools on the temperature of stored spent fuel (NUREG/CR-0649, "Spent Fuel Heatup Following Loss of Water During Storage" [March, 1979]). While this study noted that oxidation could become self-sustaining for temperatures in the neighborhood of 850-950° C (NUREG/CR-0649, page 13), the study shows that such oxidation can only occur for extreme temperature conditions and for spent fuel that has been stored for a relatively brief storage period. In order for rapid oxidation to occur, the age of the spent fuel (30,000 MWD/MT burnup) would have to be in the range of less than 10 days to less than two years, depending on the density at which it is stored (see page 55, Figure 17 of NUREG/CR-0649). Moreover, one must assume a continuing oxygen supply adequate to sustain the oxidation. Any damaged spent fuel such as that from TMI-2, would be canned to avoid particulate loss and would have already aged several years. Neither the heat load leading to temperatures capable of initiating rapid oxidation nor the presence of an adequate supply of oxygen to sustain a pyrophoric reaction would seem to be present in any storage configuration or under conditions that would receive NRC approval. While it is correct that spent fuel has not been stored for over 30 years, the record shows that utilities have successfully stored spent fuel for over 20 years, and that there are no known physical processes which would indicate that it is impractical to extrapolate that experience to make predictions about the behavior of spent fuel for 70 years of storage.

The Utility Nuclear Waste Management Group—Edison Electric Institute and the U.S. Department of Energy referred to several documents in the record which show that the relatively low energy content of spent fuel and the relatively benign static environment of spent fuel storage render insignificant the radiologic impacts arising from extended storage of spent fuel. As discussed in more detail below, these documents also show that there are no significant non-radiologic environmental impacts arising from such extended storage. Under these circumstances, the Commission finds that it has sufficient experience with spent fuel storage to predict spent fuel behavior during 70 years of storage and to find that such storage will not result in significant environment effects.

B. Non-Radiological Consequences of Spent Fuel Storage

The Commission's fourth finding rested in part on the Commission's determination that there are no significant non-radiological consequences due to the extended storage of spent fuel which could adversely affect the environment. The public was invited to comment also on this finding and to provide a detailed discussion of any such environmental impacts. Mr. Marvin Lewis asserted that the continuous storage of spent fuel under water for 30 years or more requires unprecedented institutional guarantees. He also noted that there had been no consideration of financial, economic and security implications of storage for 30 or more years. Mr. Lewis did not expand upon these assertions to explain how they would result in significant non-radiological environmental consequences. In any event, the more than twenty years of experience with storing spent fuel demonstrates that storage of spent fuel for 30 years or more does not require unprecedented institutional guarantees or raise unique questions regarding finances, economics or the security of extended spent fuel storage. Further, the Commission will require all reactor licensees, 5 years before expiration of their operating license to provide a plan for managing the spent fuel prior to disposal. Moreover, the record documents referred to by UNWMG-EEI, DOE and AIF show that there are no significant non-radiological environmental impacts associated with the extended storage of spent fuels. The amount of heat given off by spent fuel decreases with time as the fuel ages and decays radioactively. No additional land needs to be devoted to storage facilities because reactor sites have adequate space for additional spent fuel pools or dry storage installations. The additional energy and water needed to maintain spent fuel storage is also environmentally insignificant. No commentor has challenged these assessments of environmental impacts and the Commission has no reason to question their validity. Under these circumstances, the Commission has no reason to reassess its prior determination that extended storage of spent fuel will present no significant non-radiological consequences which could adversely affect the environment.

3. Commission Compliance With NEPA

Several participants challenged the Commission's compliance with NEPA. The States of New York ("New York") and Wisconsin contend that since its inception, this proceeding has focused on the availability and safety of spent fuel storage, and has been conducted outside the scope of NEPA. New York supports this contention with the following quote from the First Prehearing Conference Order (February 1, 1980):

> This rulemaking proceeding does not involve a major federal action having a significant impact on the environment, and consequently an environmental impact statement is not required by NEPA.

New York asserts that this statement caused the participants not to consider NEPA in their filings. Accordingly, New York believes that the Commission cannot now transform the Waste Confidence Proceeding into a NEPA proceeding. In New York's view, joined by the Natural Resources Defense Council, Inc. ("NEDC"), NEPA required the Commission to prepare an environmental impact statement ("EIS") or environmental assessment to consider the environmental impacts of spent-fuel storage at reactor sites beyond the expiration dates of reactor licenses. The Utility Nuclear Waste Management Group-Edison Electric Institute ("UNWMG-EEI") believes that it has been clear from the outset of this proceeding that the Commission intended to develop environmental regulations appropriate to the issues considered here. UNWMG-EEI cites several factors in support of its position:

(1) this proceeding was the direct outgrowth of a NEPA case, *Minnesota* v. *NRC*, 602 F.2d 412 (D.C. Cir. 1979); (2) the Notice of Proposed Rulemaking explicitly stated a Commission intent to deal with environmental aspects of spent fuel storage; (3) the proceeding was docketed under Part 51, the Commission's regulations implementing NEPA; (4) the Commission stated that it would draw on the record of the rulemaking on environmental impact of the nuclear fuel cycle (Table S-3) and included in the NRC Data Bank for this proceeding sources of information on the environmental impacts of spent fuel storage; and (5) several participants included in their statements information pertaining to the environmental impacts of spent fuel storage.

The Commission believes that from the very beginning of this proceeding, participants were on notice that environmental aspects of spent fuel storage were under consideration. The notice initiating this proceeding stated, in pertinent part:

> If the Commission finds reasonable assurance that safe, off-site disposal for radioactive wastes from licensed facilities will be available prior to expiration of the facilities' licenses, it will promulgate a final rule providing that the *environmental and safety implications of continued on-site storage after the termination of licenses* need not be considered in individual licensing proceedings. In the event the Commission determines that on-site storage after license expiration may be necessary or appropriate, it will issue a proposed rule providing *how that question will be addressed.*
>
> * * * * *
>
> Based on the material received in this proceeding and on any other relevant information properly available to it, the Commission will publish a proposed or final rule in the Federal Register. Any such final rule will be effective thirty days after publication.
>
> 44 FR 61372, 61273–61374 (1979). (Emphasis supplied).

It is clear from this notice that if the Commission found that onsite storage after termination of reactor operating licenses would be necessary or appropriate, then it would propose a rule for dealing with the question of environmental and safety implications of continued onsite storage. New York's reference to the statement in the First Prehearing Conference Order is inapposite. That statement addressed the issue of whether a decision in this proceeding would be a proposal for major federal action having significant impact on the environment so as to require an EIS. The Presiding Officer found that the decision itself would not require an EIS. His decision in no way implied a change in the scope of the proceeding as announced in the notice initiating it.

There is also nothing about the Commission's fourth finding which requires an EIS. Neither New York nor NRDC has explained how this finding is a major federal action having a significant impact on the human environment. The finding provides a basis for a rule that provides that environmental impacts from extended storage of spent fuel are so insignificant as not to be required to be included in an impact statement. The validity of such a rule depends on the procedures used to promulgate it and the record supporting it. An EIS is not required because such a rule itself has no environmental impacts, significant or otherwise.[8] To require an EIS here would be essentially to require an EIS to show that no EIS is required. Clearly such a result would be incorrect. Accordingly, the Commission finds that NEPA does not require an EIS to support the fourth finding.

4. List of Respondents

Respondents to the Commission's November 3, 1983 Order (48 FR 50746) To Reopen the Period for Limited Comment on the Environmental Aspects of the Commission's Fourth Finding in the Waste Confidence Proceeding

1. Attorney General of the State of New York (N.Y.)
2. Marvin Lewis (Lewis)
3. Sierra Club Radioactive Waste Campaign (Sierra)
4. Scientists and Engineers for Secure Energy, Inc. (SE2)
5. Safe Haven, Ltd. (S.H.)
6. American Institute of Chemical Engineers (AICE)
7. Atomic Industrial Forum, Inc. (AIF)
8. Utility Nuclear Waste Management Group—Edison Electric Institute (UNWMG–EEI)
9. Natural Resources Defense Council, Inc. (NRDC)
10. Attorney General of the State of Wisconsin (Wis.)
11. U.S. Department of Energy (DOE)
12. American Nuclear Society (ANS)
13. Attorney General of the State of Minnesota (Minn.)

Appendix—Rationale for Commission Findings in the Matter of the Waste Confidence Proceeding

Table of Contents

1.0 Introduction

The rationale for the five Commission findings resulting from the Waste Confidence proceeding is summarized below. This rationale is based principally on the record of the proceeding which includes participants' position statements, cross-statements, pre-hearing and oral statements (in the discussion below, the participants are identified by the citations defined in the Reference Notation at the end of this document). The Commission also relied on the provisions of the Nuclear Waste Policy Act of 1982 (NWPA), and other substantive material not originally included in the record relating to the discussion of the safety of dry storage of spent nuclear fuel in the Commission's Fourth Finding; the NWPA and the dry storage material have now been incorporated into the record along with the relevant comments of participants in this proceeding.

The Commission notes that two relevant developments have occurred subsequent to the closing of the record in the Waste Confidence proceeding.

[8] See, for example, *Natural Resources Defense Council, Inc., v. U.S. Nuclear Regulatory Commission*, 547 F.2d 633, 653, n. 57 (D.C. Cir. 1976), *reversed on other grounds, sub nom, Vermont Yankee Nuclear Power Corp. v. NRC*, 435 U.S. 519 (1978).

They are the publication of DOE's draft Mission Plan for the Civilian Radioactive Waste Management Program (April, 1984) and the Commission's concurrence in DOE's General Guidelines for Recommendation of Sites for Nuclear Waste Repositories (July 3, 1984). These developments are a matter of public record, and in the case of the Commission's concurrence was the conclusion of a separate public proceeding. The Commission has considered the effects of these developments on its previously announced decision in this proceeding and determined that these developments do not substantially modify the Commission's previous conclusions.

2.0 Rationale for Commission Findings

2.1 First Commission Finding

The Commission finds reasonable assurance that safe disposal of radioactive waste and spent fuel in a mined geologic repository is technically feasible.

The Commission finds that safe disposal of high-level radioactive waste and spent fuel is technically possible and that it is achievable using existing technology. Although a repository has not yet been constructed and its safety and environmental acceptability demonstrated, no fundamental breakthrough in science or technology is needed to implement a successful waste disposal program. Those participants who questioned the availablity of a repository did not contend that fundamental scientific breakthroughs were required, but questioned whether technical problems could be resolved in a timely manner. The record supports the conclusion that the safe disposal of high level radioactive waste and spent nuclear fuel from licensed facilities can be accomplished.

The Department of Energy's (DOE) position is that disposal in mined geologic repositories can meet the goal of providing safe and effective isolation of radionuclides from the environment (DOE PHS pp. 2, 4; Tr. p. 11). A number of participants stated that waste containment and isolation from the biosphere are scientifically feasible (USGS PS p. 4; NRDC PS p. 9; UNWMG–EEI PS, Doc. 1 p. 22, Doc. II p. II–6; Consolidated Industry Group Tr. p. 16; Consolidated States Group Tr. p. 98). This view is consistent with the conclusions of the *Report to the American Physical Society by the Study Group on Nuclear Fuel Cycles and Waste Management (Rev. Mod. Phys.,* Vol. 50, No. 1, Pt. II, p. S6, Jan. 1980) and the *Report to the President of the Interagency Review Group on Nuclear Waste Management* (Final Report, March, 1979, p. 38).

The conclusion that safe radioactive waste disposal is technically feasible is based on consideration of the basic features of repository design and the problems to be solved in developing the final design. A mined geologic repository for disposal of high-level radioactive waste, as developed during the past three decades, will be based on application of the multi-barrier approach for isolation of radionuclides. The high-level radioactive waste or spent fuel is to be contained in a sealed package and any leakage from the package is to be retarded from migrating to the biosphere by engineered barriers. These engineered barriers include backfilling and sealing of the drifts and shafts of the mined repository. We believe that the isolation capability and long-term stability of the geologic setting provide a final barrier to migration to the biosphere.

The selection of a suitable geologic setting is one of the key technical problems which DOE must solve. Other problems include development of waste packages that can contain the waste until the fission product hazard is greatly reduced and engineered barriers that can effectively retard migration of radionuclides out of the repository. The Commission recognizes that these three problems are not only the ones which DOE's program must solve, but they are critical components of the multi-barrier approach for nuclear waste isolation. Much of the discussion in this proceeding has focused on these problems. We have reviewed each of these issues and have concluded that they do not present an insoluble problem which will prevent safe disposal of radioactive waste and spent fuel.

A. The Identification of Acceptable Sites

There is general agreement among the participants that the period during which the wastes must be isolated from the biosphere is at least several millenia and that such prolonged isolation can be achieved in a deep mined respository provided the geologic setting is suitable. The geologic setting is the "final" isolating barrier. If the waste package and engineered barriers fail to perform as expected, the geologic barrier must prevent harmful quantities of radioactive materials from entering the human environment.

The Commission believes that technically acceptable sites exist and can be identified. In many locations in the continental United States there are geologic media potentially suitable for a waste repository. These media occur in large, relatively homogeneous and unfaulted formations and have properties (e.g., mechanical strength, thermal stability, impermeability to water which qualify them as potential host rocks for radioactive wastes. The potential host rocks include those being investigated by DOE—that is, domed salt, bedded salt, tuff, basalt, granite, and shale (DOE PS pp. II–70 to II–80.). Thousands of square miles of the United States are underlain with formations containing extensive masses of such potential host rocks. Moreover, more than one-half of the United States is underlain with rock that has been stable against significant deformation and disruption for over ten million years. The potential sites being investigated by DOE are in regions of relative tectonic stability (USGS PS pp. 19, 23, 24, 25, 26, 28; Tr. p. 236).

Host rock suitability and formation stability are not the only relevant technical factors to be considered in repository site selection. Geohydrologic conditions—particularly the absence of significant groundwater flow from the repository to the biosphere—must be favorable for effective isolation of the wastes (USGS PS p. 11). DOE's investigations reveal that the hydrologic characteristics of a major portion of the sites underlain with stable formations of potential host rock appear to be suitable for repository location (Tr. p. 236; DOE PS p. II–77).

These general conclusions about the extent of potential repository sites are based on the results of DOE's site exploration program (DOE PS Appendix B) and the extensive body of earth-sciences information available at the United States Geological Survey—the Federal agency principally concerned with earth-sciences issues and, under a DOE–USGS Memorandum of Understanding, a primary source of geologic, hydrologic and mineral resource data for the National Waste Terminal Storage program (USGS PS p. 2 and Appendix A; DOE PS p. III–44).

DOE's site exploration efforts are focused on four host rocks (domed salt, bedded salt, basalt, and tuff) in six regions (Gulf Interior, Paradox Basin, Permian Basin, Salina Basin, DOE Hanford Site, DOE Nevada Test Site) (DOE PS Appendix B). Although investigations of granite sites in the U.S. have been limited, DOE is developing data on the potential of granite as a host rock in collaboration with foreign investors. A Swedish-American cooperative program (DOE's Lawrence Berkeley Laboratory is the U.S. principal in the program) has involved a series of *in situ* tests in a granite formation

conducted at the Stripa mine in Sweden. The investigations included determinations of thermally induced stresses and deformations in the granite rock mass. Another cooperative study at Studsvik in Sweden involved experiments in nuclide migration in fractured subsurface crystalline rocks (DOE PS p. II–258).

Some participants objected to the fact that most of DOE's site exploration involved federally-owned or -controlled areas, arguing that this would result in ignoring sites that were technically better (NRDC PS p. 17; Tr. p. 206). This objection, apparently based on the assumption that Federal lands investigated were limited in area and geologic diversity, is not supported by the record. The Federal lands being investigated by DOE are extensive and geologically diverse; moreover, they are more readily accessible to DOE and some of them, such as Nevada Test Site, have been previously subjected to extensive geologic assessment. These latter factors are significant advantages (DOE PS Appendix B; UNWMG–EEI CS p. IV B–4). Although, as the United States Geological Survey pointed out, there may be advantages from a purely earth-science viewpoint in examining all parts of the country for their potential as repositories, time and resource limitations require that site exploration efforts be concentrated in limited regions fairly early so that detailed site-specific characterization efforts can be undertaken in a timely way (USGS PS p. 17).

A specific site has not yet been identified as technically acceptable, and investigations of potential sites have shown some to be unsuitable. This does not necessarily mean that DOE's site selection program will be unsuccessful in identifying technically acceptable sites. The elimination of some sites is to be expected in a pursuit of the site selection program and is not, as some participants implied, an indication that suitable sites cannot ultimately be found.

Although the record of this proceeding does not show that DOE has progressed far enough in site characterization to confirm the existence of an acceptable site, the record does indicate that DOE's site characterization and selection program is technically sound. The data obtained in each stage of the screening process are analyzed and compared against criteria that must be satisfied for adequate performance of the total isolation system. DOE's program is providing information on site characteristics at a sufficiently large number and variety of sites and geologic media to support the expectation that one or more technically acceptable sites will be identified (DOE PS pp. III–8 to III–24; CS p. II–140). As discussed above, DOE's site screening efforts have concentrated on a diverse set of potentially suitable geologic media and are directed to an examination of large areas of the country on both federally-owned and non-federal lands (USGS PS p. 17).

The technology for site identification is particularly well-advanced (UNWMG–EEI PS p. III–A–b79). The record describes numerous site characterization techniques, both remote sensing and *in-situ*, which are being used to evaluate sites (DOE PS pp. II–84 to II–103). The location and demonstration of acceptability of repository sites are problems which can be solved by the investigative and analytical methods now available (AEG PS p. 1). Site selection criteria are being refined (DOE PS pp. II–80 to II–83; 48 FR 5671, February 7, 1983) and the technology exists for site characterization (DOE PS pp. II–84 to II–103). Areas have been found where most natural geologic and hydrologic processes operate at rates favorable to long-term containment in a mined repository (DOE PS p. II–128; Consolidated Industry Group PHS p. 9).

The Commission recognizes that there are gaps in the current state of knowledge about potential repository sites and geologic media, and about geochemical processes which affect radionuclide migration (e.g., CEC PS pp. 17, 54; NRDC PS pp. 18, 50, 64; NY pp. 38, 80; USGS CS pp. 5, 6). The gaps include a lack of a detailed understanding of such relevant processes as sorption of radionuclide-bearing molecules by the geologic media, leaching of the wastes by groundwater, and radionuclide migration through subsurface formations. Some participants contend that these gaps and uncertainties in knowledge make it difficult to predict on the basis of any effort less than a detailed on-site investigation whether a candidate repository site will be technically suitable (e.g., NRDC PS pp. 18, 50, 53; ECNP PS pp. 3, 4; NECNP PS pp. 20, 21, 22).

The Commission recognizes that detailed site characterization is necessary to confirm that a proposed site is indeed suitable. The Commission does not believe, however, that all uncertainties must be resolved as a pre-condition to repository development. The performance of a repository may be bounded by using conservative values for controlling parameters, such as waste form solubility, ground water travel time and retardation of radionuclides. Furthermore, bounding analyses can be useful to take residual gaps in knowledge and uncertainties into account. If it can be established that a repository can perform its isolation function using established, conservative values for the controlling parameters, then it is not necessary to resolve uncertainties in the range of value these parameters may exhibit (DOE CS pp. II–83, II–84, II–130, III–9, III–12).

The statements of those participants who are pessimistic about timely accomplishment of disposal tend to assign equal importance to all areas of uncertainty. Hence, they contain few attempts to assess the consequences of gaps in knowledge or to project the benefits of expected results from ongoing research and development efforts. It is the Commission's belief that the waste isolation system elements are adequately understood so that major unforeseen surprises in results of research and development are highly unlikely. This view is supported by USGS (USGS CS pp. 1–2).

A further concern of some participants is that, even if DOE were to identify a potentially acceptable repository site, the *in-situ* testing required to determine acceptability would breach the integrity of the candidate site (NY PS pp. 59, 63–65). If, for example, boreholes essential to characterize a potential site result in penetration of aquifers which are not amenable to effective sealing, this might make the site unacceptable (DOE PS pp. II–161 to II–164). However, no persuasive evidence was presented in the record to support the position that *in-situ* tests for site characterization work are likely to compromise the integrity of candidate sites. The Commission believes that *in-situ* tests can be successfully accomplished without adversely affecting site integrity for the following reasons. Many non-destructive remote sensing methods are available for determining site characteristics. Further, boreholes can be located in shafts or pillars of the future repository to minimize the possibility of leakage through them.

As discussed later, borehole sealing methods are expected to be adequate. The number of boreholes necessary to adequately characterize a site can be minimized by careful planning and by use of remote sensing methods in conjunction with the drilling program (DOE PS pp. II–84 to II–103, II–181). Finally, the Commission believes that if a site is found to be sufficiently sensitive to the testing program so that its integrity would be destroyed, then

that site would necessarily be found unacceptable.

In summary, the Commission believes that technically acceptable sites for disposal of radioactive waste and spent fuel exist and can be found. There are a number of suitable host rock type to select from; many areas are underlain with massive, stable formations containing these host rocks; the areas being investigated by DOE contain such rock formations; and the uncertainties in knowledge of the earth and material sciences relevant to the identification of an acceptable repository site are not fundamental uncertainties that would prevent the identification of technically acceptable sites. Further, *in-situ* testing required to characterize a candidate site would not necessarily compromise its integrity.

B. The Development of Effective Waste Packages

1. *Waste Package Considerations.* An important technical aspect of safe waste disposal is to assure that the waste form and the balance of the waste package, including the primary container and ancillary enclosures, are capable of containing the radioactivity for a time sufficient for the hazard from fission-product activity to be significantly reduced (e.g., DOE PS p. II–8). Decay heat, groundwater and nuclear radiation could cause the waste package components to interact with each other or with the host rock materials in such a way as to degrade the ability of the package to contain the radionuclides. These items are discussed below.

To assure long-term containment, DOE's conceptual design of a waste package is based on a defense-in-depth approach and involves a number of components including spent fuel, stabilizer (or filler), waste canister, overpack, and an emplacement hole sleeve. The stabilizer is intended to improve heat transfer from the spent fuel, to provide mechanical resistance to possible canister collapse caused by lithostatic pressure, and to act as a corrosion-resistant barrier between the spent fuel and the canister. Selection of canister overpack and emplacement hole sleeve materials will be based on tests of their chemical and physical integrity at various temperatures and levels of radiation and under various conditions of groundwater chemistry, as well as tests of their compatibility with each other and with the host rock materials under repository conditions. The canister, overpack, and sleeve should constitute relatively impermeable elements of the waste package. A variety of candidate materials is being considered for these elements. The various waste package components are to be combined in a conservative design that will compensate for the overall technical uncertainties in containment capability. The requirement for retrievability during some specified period after emplacement places conditions (e.g., ruggedness) on waste package design which are added factors to be considered in its development (DOE PS p. II–129 to II–152, II–282).

It is apparent from the foregoing that the development of an effective waste package depends on obtaining engineering data on those materials that appear to be promising candidates for package components. DOE is studying over 28 candidate materials for canisters and overpack (DOE PS p. II–143). The DOE evaluation program indicates that many of these materials are promising. For example, iron alloys have demonstrated long term durability (DOE PS p. II–144, Reference 383), and titanium alloys and nickel alloys show high resistance to corrosion (DOE PS p. II–144, Refs. 315, 338, 342). Ceramics are resistant to chemical degradation and have many other desirable properties (DOE PS p. II–145, Refs. 337, 347, 348 and 349). Preliminary analysis indicates that mild steel canisters with an appropriate backfill material would be a feasible waste package for either a salt or hard rock repository. For more demanding requirements, such as brine applications, the alloys of titanium, zirconium or nickel appear to represent alternate choices (DOE PS p. II–150, Refs. 337, 382). The DOE program also includes experimental studies of the release of radioisotopes from spent fuel exposed to simulated repository conditions (e.g., salt brine and fresh water with varying dissolved oxygen content). The studies are being conducted under temperature and pressure conditions that bound and exceed repository conditions (DOE PS pp. II–139 to II–141).

Not all participants were optimistic about waste package development. One participant asserted that in spite of DOE's efforts to develop a package that would remain inert and stable under repository conditions, none had yet been found and the DOE program would not succeed in finding one (NRDC PS p. 46). Other participants pointed to the limits of present knowledge, particularly about the leaching of radioisotopes from spent fuel in a groundwater environment, and concluded that it is not possible to select a waste form which will prevent radioisotopes from migrating to the biosphere (e.g., CEC PS p. 51). They also pointed out that chemical and physical properties of spent fuel varied widely and depended on burnup, location within the reactor core, age, and physical integrity; design of a system of barriers to accommodate this heterogeneity within the context of a given geohydrologic environment would be a major undertaking (NY PS p. 83).

The Commission recognizes the difficulties which must be overcome in developing a suitable waste package. A large body of experimental data must be accumulated and applied to a variety of candidate arrangements of waste package components. Suitably conservative assumptions must be postulated to define the repository conditions. Data from experiments of relatively short duration have to be used to predict behavior for much longer periods. It is common practice in materials research to perform short-duration experiments under physical or chemical conditions much more severe than those expected for the longer duration and, from known fundamental properties of the materials under investigation, to extrapolate the experimental data to predict long-term behavior. Conservatism can usually be assured by making the experimental conditions sufficiently severe.

The complex composition of the mixture of radionuclides in fission products and their basic chemical properties are known and have been the subject of investigation for more than three decades. The large body of published data on fission product chemistry and experience with fission product mixtures should provide considerable support for predicting the behavior of spent fuel and high-level radioactive waste in waste package designs.[1] The Commission, therefore, concludes that the chemical and physical properties of spent nuclear fuel and high-level radioactive waste can be sufficiently understood to permit the design of a suitable waste package.

The Commission also concludes that the DOE program is capable of developing a suitable waste package which can be disposed of in a mined geologic respository. This conclusion is based upon the large number of candidate materials being considered by DOE, the detailed evaluation of these

[1] Published compilations of such data, although not specifically included in the record of this proceeding, are well known to the nuclear science and engineering community. Examples are the three volumes of the National Nuclear Energy Series, "Radiological Studies: The Fission Products," by C. D. Coryell and N. Sugarman, McGraw-Hill, 1951; "Reactor Handbook," Second Edition, Vol. II, Fuel Reprocessing, edited by S.M. Stoller and R.B. Richards, Interscience Publishers, Inc., New York, 1961).

materials to be conducted as part of the DOE program and the results of DOE's preliminary analysis of candidate materials, as described above (see Sec. 2.1(b)(1)). The Commission's conclusion that the development of a suitable waste package is technically feasible is also consistent with other material in the record. For example, a study sponsored by the National Academy of Sciences (NAS) concluded that no insurmountable technical obstacles were foreseen to preclude safe disposal of nuclear wastes in geologic formations (UNWMG–EEI PS Doc. 2 p. II–6). The United States Geological Survey stated that a long-lived canister is within the capability of materials science technology to be achieved in the same time frame as repository site identification, qualification and development (USGS PS p. 11). The National Research Council, after reviewing the Swedish waste disposal work (DOE PS p. II–335 Ref. 380), concluded that the Swedish waste package could contain the radionuclides in spent fuel rods for hundreds of thousands of years (DOE CS p. II–98).

2. *Effect of Reprocessing on Waste Form and Waste Package.* The waste form itself (spent fuel or other high-level waste) serves as the first barrier to radionuclide release and thus supplements the containment capability of the other components of the waste package as well as the repository's natural isolation capability. Throughout this processing it has been assumed that the waste form would be spent fuel discharged from light water reactors, with mechanical disassembly for volume reduction and packaging in a canister as the only potential modifications. The relevant properties of the spent fuel (irradiated uranium dioxide pellets and zircaloy cladding) are known. DOE's program has been directed toward providing data to determine the behavior of spent fuel as a waste package component under repository conditions. In its Position Statement DOE stated that the "representative case" to be considered in this proceeding is the disposal and storage of spent fuel from commercial reactors and that this does not foreclose "other approaches, such as the reprocessing of spent fuel and solidification of resultant nuclear wastes" (DOE PS p. I–2).

On August 27, 1981 the National Resources Defense Council filed a Motion for Judgment requesting a prompt ruling that, on the basis of the present record, there is not reasonable assurance that off-site storage or disposal will be available by the year 2007–09. NRDC stated that, because the present Administration [1] had changed Federal policy towards commercial reprocessing of spent fuel (reprocessing was deferred "indefinitely" in April 1977 by the previous Administration), the disposal of spent fuel would be contrary to the present Administration's policy, and thus spent fuel was no longer a valid "reference waste form" for this proceeding. As a consequence, according to NRDC, DOE schedules and timetables, which were based on spent fuel storage and disposal, were irrelevant. The NRDC view was challenged by DOE as well as by seven participants representing utilities and the nuclear industry. The Commission took note of the NRDC filings and the responsive filings by other participants, considering them part of the record, and in its November 6, 1981 Second Prehearing Memorandum and Order asked the participants to address the significance of commercial reprocessing to the Commission's decision in the waste confidence proceeding. In response, the participants addressed this change in government policy in their prehearing statements filed in December 1981.

In response to those who argued that the change of reprocessing policy invalidated DOE's position, DOE stated that the program for development of the technology is not dependent on the waste form. Moreover, DOE pointed out that the purpose of this proceeding—"to determine whether there is at least one safe method of disposal or storage for high-level radioactive waste" is not changed by this Administration's support of reprocessing of spent fuel (DOE PHS pp. 2–3). Some participants who agreed with DOE commented that spent fuel disposal involves greater difficulty than disposal of solidified reprocessing waste because of its higher radioactivity and less easily handled form; in addition, they asserted that the removal of the uranium and most actinides by reprocessing would ease the requirements for safe long-term storage and simplify the waste disposal problem (UNWMG–EEI PHS p. 16; SE2 PHS p. 4). Others contended that spent fuel is a more difficult waste form because heat dissipation and packaging problems involved in disposal appear to be more severe than in disposal of solidified reprocessing waste (AIF PHS p.6; ANS PHS p. 5).

The Commission recognizes that the proceeding has been primarily concerned with storage and disposal of spent fuel. However, the Commission does not believe that the possibility of future reprocessing, and the potential need to dispose of high-level radioactive waste resulting from reprocessing, significantly alters the technical feasibility or the schedule for developing a mined geologic repository and the design of its multiple barriers.

With regard to technical feasibility, the effect of spent fuel reprocessing on the commercial radioactive waste disposal problem is not a new consideration. The disposal of waste from reprocessing spent fuel has been studied for a longer time than the disposal of spent fuel. Until 1977, the commercial waste management program was directed primarily toward disposal of waste from spent fuel reprocessing, and those efforts have continued. A variety of waste forms has been studied (DOE PS pp. II–153 to II–160). Thus, considerable information is already available on the technical feasibility of developing a suitable waste form for reprocessed high-level radioactive waste. In fact, there is evidence that the disposal of reprocessed high-level waste may pose fewer technical challenges than the disposal of spent fuel (Tr. p. 29). Moreover, commercial reprocessing of spent fuel cannot be undertaken in this country in the absence of a full NRC licensing review. That review will consider, among other things, the waste form to be produced by the reprocessing method and its implications for waste disposal. Unless the Commission determines that commercial reprocessing and management of its products assure adequate protection to the public health and safety and the common defense and security, spent fuel will continue to be the predominant commercial waste form available for disposal in a repository.

With regard to the impact on DOE's repository schedule, the Commission recognizes that DOE's waste package development program will eventually be affected to some extent by the nature of the waste form under development. However, the direction taken in research and evaluation of materials being conducted in the DOE program is expected to produce results which would be relevant to the waste package design, regardless of which waste form is used (DOE PS pp. II–141 to II–152, CS pp. II–96 to II–100). Moreover, the choice of waste form will not significantly affect other elements of the DOE repository program. The storage and disposal of reprocessed waste would involve substantially the same problems as those being addressed for spent fuel;

[1] The NRDC statement was based on DOE testimony before a Congressional committee. The President's Nuclear Policy Statement of October 8, 1981 confirmed the DOE testimony.

and a change in waste form would not alter the site-selection program or the program for development of suitable engineered barriers (DOE PHS p. 3). Thus, DOE's program is proceeding on a basis that would permit the disposal of either high-level waste or spent fuel. This approach is consistent with the recommendations of the Interagency Review Group in its March 1979 report to the President (IRG Final Report, p. 73) and with the direction in the Nuclear Waste Policy Act of 1982 (Sec. 111(a)(2)). Finally, as noted above, any decision to permit the commercial reprocessing of spent fuel will include consideration of the reprocessed waste form and its implications for waste disposal. For these reasons, the Commission concludes that the possibility of commercial reprocessing does not substantially alter the technical feasibility of, or the schedule for, developing a suitable waste package.

The Commission concludes that the basic knowledge of spent fuel and high-level waste and its behavior in a repository environment, together with DOE's ongoing development and testing program, are sufficient to provide assurance that a waste package can be developed that will provide adequate containment until the potential hazard from the fission product activity is sufficiently reduced.

C. The Development of Effective Engineered Barriers for Isolating Wastes From the Biosphere

1. *Backfill Materials:* In DOE's conceptual design, one engineered barrier consists of backfill materials for filling voids between canister, overpack, sleeve and host rock. The materials are chosen to retard radionuclide migration. The task is to design and test barrier materials which will be effective for very long periods of time. Candidate materials include bentonite, zeolites, iron, calcium or magnesium oxide, tachyhydrite, anhydrite, apatite, peat, gypsum, alumina, carbon, calcium chloride, crushed host rock, and others (DOE PS p. II–147). Host rock or other materials would also be used to backfill drifts and shafts within the repository.

The California Department of Conservation (CDC) contends that repository shaft and borehole backfill material performance may be degraded as a result of increased temperature and other factors (CDC PS pp. 19–22). However, the expected temperature rise in the shaft backfill material will be only about 10 Farenheit degrees, and will cause no significant degradation of the shaft backfill material (DOE, PS p. II–347 Ref. 527 NUREG/CR 0495). Other participants believe that there is inadequate information to permit development of long-lived engineered barriers that will effectively contain high-level radioactive wastes (NRDC PS pp. 18, 32; I11 PS pp. 3–4; NECNP PS p. 18). CDC further contends that at this time, no information appears to have been developed that specifies the best type of backfill material to be used in particular geologic media (CDC PS pp. 19–22). However, the choice of backfill must take into account the rock media at the selected site as well as the waste package material. Thus, the backfill cannot be selected until a repository site has been selected. The NWTS program has as its objective, providing information on a practical range of options for backfill materials. Although a considerable amount of work remains to be done, an active research and development program on backfill materials is underway (DOE PS p. II–147). Further, that program is providing information to evaluate the backfill material options, as well as to establish a basis for selection of a suitable material for the geologic media being considered. The Commission believes that this approach provides an adequate basis for concluding that effective backfill materials will be identified in a timely fashion.

In the National Waste Terminal Storage program a wide range of candidate backfill materials have been and are continuing to be evaluated (DOE PS II–129 to II–152). The DOE studies include measurements of the appropriate properties of backfill material including nuclide sorption capacities, capability to prevent or delay ground water flow, thermal conductivity, mechanical strength, swelling, plastic flow and methods of backfill emplacement. Data on available candidate materials show significant radionuclide sorption capabilities and sorptive properties can be maintained at elevated temperature and in the presence of radiation (DOE CS pp. II–98, II–99). Analyses indicate that several of the materials could provide adequate performance characteristics (DOE PS, Part II, Ref. 339, 340, 346, 372, 374, 376). As an example of the development of effective engineered barriers, the results of Swedish studies on radionuclide release in a repository were cited. The studies showed that a bentonite clay backfill, in conjunction with a thick copper canister (with spent fuel inside) could prevent the release of radionuclides to the host rock in the presence of granitic ground water for thousands to hundreds of thousands of years. In the Swedish experiments, the clay barrier provided sorptive properties which were predicted to delay the breakthrough of various radionuclides for thousands of years and also served to chemically condition the ground water, reducing its corrosive effect on the canister (DOE PS pp. II–145, II–148). The use of certain clays to retard the transport of radionuclides released by the waste package is applicable to repository designs here in this country. While DOE has not proposed using thick copper canisters as employed in the Swedish studies, this example of a durable combination of waste package and backfill material which was demonstrated to be effective in isolating radionuclides for very long times, indicates that the basic approach is reasonable. The use of clays, combined with other appropriate materials, could provide an effective means for radionuclide retardation and corrosion control.

In sum, the Commission believes that DOE's ongoing developmental studies reported in this proceeding (DOE PS pp. II–129 to II–152) are technically sound and provide a basis for reasonable assurance that engineered barriers can be developed to isolate or retard radioactive material released by the waste package.

2. *Borehole and Shaft Sealants.* A major factor in repository performance is the effective sealing of boreholes and shafts during repository closure operations. All penetrations provide potential pathways for radionuclides to reach the biosphere or for ground water to enter the repository. The penetrations must be sealed for an extended period of time. Further, the geology and hydrology at a particular site, as well as the expected temperature and pressure conditions during repository lifetime, must be understood in order to make a proper choice of the borehole and shaft sealing materials and to develop effective borehole and shaft seals.

Some participants concluded that current information concerning the technology for the sealing of the boreholes and shafts is inadequate. They also questioned the capability of the DOE program to develop sufficient information to allow effective seal design (CDC PS pp. 19–22; NRDC PS p. 5). The views of several participants who expressed concern about sealing were reflected in the comments of CDC. The Commission's response to each of the points raised by CDC on borehole and shaft sealing issues is discussed below.

CDC indicated that since long-term effects of heat and radiation on seal materials were not a factor in past oil and gas borehole sealing experience,

such experience is not applicable to repository sealing.[3] However, at distances of more than several feet from waste canisters emplaced in a repository, radiation exposures are small and the temperature rise at seals in the shafts and boreholes is insignificant for sealing purposes (DOE CS II–108).

CDC also believes that the tests of cement seals with epoxy resins in bedded salt deposits discussed by DOE are insufficient to provide assurance of seal stability over a period of 10,000 years, especially when the effects of higher temperature and radiation are not included. As noted above, temperature and radiation effects on seals are expected to be negligible.

While these tests may not provide conclusive proof of performance for 10,000 years, they are expected to provide useful information for seal development.

CDC states that the results of field tests described by DOE as continuing over the next few years will not be completed in time to contribute to seal design criteria which are to be completed [4] in 1982. However, the final seal design for the selected site is scheduled for two years after a site is selected (DOE PS p. II–184). Testing up to that date is expected to be useful in designing an effective seal.

CDC questioned whether tests of waste package system component interactions with the surrounding media in bedded salt described by DOE will be completed in time for location of a repository. However, the Commission finds no basis for this assertion in the record. The DOE program appears to be adequately addressing this issue. Studies are in progress to characterize further the interactions between candidate backfill-getter materials and waste container alloys. These studies include investigations of dry rock salt/metal interactions and high intensity radiation/salt/brine/metal interactions. (DOE PS p. II–149, II–150).

CDC asserts that DOE has not discussed designing backfill material and penetration seals to allow for safe reentry if retrieval should become necessary. However, the provision to retrieve high-level waste and spent fuel for a number of years after the repository is filled has been addressed by DOE (DOE PS pp. II–280 to II–283). Although it has not yet been established whether backfilling and sealing will be conducted before repository closure, these operations may be reserved until a final decision for closure is made. In any event, CDC provides no basis for concluding that providing for retrievability will necessarily create any major difficulties for the design of backfill material and penetration seals.

According to one participant, "There is no established way to seal a repository so as to prevent radionuclide release to the biosphere for the necessary period of time. DOE has termed the sealing problem a 'key unknown' but there is no consensus that the technology which is currently anticipated will provide adequate seals for even a few decades" (Consolidated States Group PHS p. 8). Other participants maintained that seals must perform as well as the host rock in preventing radionuclide migration (NRDC PS p. 55). The DOE position is that the seal should provide a barrier with sufficient integrity to ensure acceptable consequences and sealing adequacy should be determined only on a site-specific basis (DOE CS p. II–106). DOE asserted that its program will successfully resolve remaining uncertainties in repository sealing technology (DOE CS pp. II–106 to II–109).

DOE has been studying cement-based borehole plugging and has examined use of grout materials for application to the Waste Isolation Pilot Plant (WIPP) and other potential repository sites. Earth-melting technology for plugging in salt and use of compacted natural earth materials are also being investigated (DOE PS p. II–183, CS p. 106–109). There is a considerable body of experience in sealing subsurface formations in the oil, gas, and other mineral extraction industries. However, related industrial experience and requirements for sealing a repository differ in one important respect: repository sealing must be effective for a very long time while most other sealing applications are for relatively short time periods (DOE PS p. II–182). Future DOE effort will be needed to verify borehole seal performance and durability for each candidate medium. An important aspect of DOE's work is to determine the rate of degradation of seal performance as a function of time. DOE plans to determine seal performance specifications for a particular site on the basis of calculated predictions of radionuclide release and transport to the accessible environment (DOE PS p. II–182). These predictions are expected to indicate that a site whose characteristics for waste isolation are clearly superior may not require sealing performance specifications as stringent as those for a less favorable site.

Based upon the extensive experience with shaft and borehole sealing in other industries and DOE's detailed program for evaluating the long-term performance of seals, the Commission believes that there is a reasonable basis to expect that long-term effective borehole and shaft seals can be developed.

D. Summary of Views on the Technical Feasibility of Safe Waste Disposal

The Commission notes that participants in the Waste Confidence Rulemaking proceeding have generally agreed there are no known fundamental technical problems which would make safe waste disposal impossible. Where they differ is the extent to which the technical problems of disposal technology and siting have already been solved and the capability of DOE to solve them, and particularly to solve them by 2007–09 or by the expiration date of reactor operating licenses (e.g., NY PS p. 3; NECNP PS p. 171; Minn PS pp. 13–20 of Enclosure).

The Commission believes that the record provides a basis for reasonable assurance that the key technical problems can be solved. Technically acceptable sites exist and can be found among the various types of geologic media and locations under investigation by DOE. Currently developed geophysical methods for site evaluation appear capable of adequately characterizing the site, and the residual uncertainties in earth sciences data do not seem to be an insurmountable impediment. Further, the Commission believes that the multi-barrier approach to waste package design is sound and that package development is being adequately addressed by DOE. DOE's development work on backfill materials and sealants provides a reasonable basis to expect that backfill materials and long-term seals can be developed. Reprocessing of spent fuel would only become a licensed commercial activity if disposal of reprocessing waste in a mined repository would be established as technically feasible. While the Commission recognizes that more engineering development and site-specific work on disposal technology will have to be conducted before a waste repository can be constructed and operated, the Commission concludes that it is technically feasible to safely dispose of high-level radioactive waste

[3] The Commission notes that the extensive oil and gas borehole sealing experience has not been concerned with very long-term sealing. Therefore, DOE's sealing research and development must provide a basis to extend that experience for the development of long-term seals for a repository.

[4] DOE has published "Schematic Designs for Penetration Seals For a Reference Repository In Bedded Salt," ONWI–405, November, 1982.

and spent fuel in a mined geologic repository.

2.2 Second Commission Finding

The Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007–09, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

While the record of the proceeding supports a finding that disposal is technically achievable, the Federal government has, in the past, made inadequate progress in developing sound waste management policies and programs. The Commission notes that DOE has stated in its April 1984 draft Mission Plan that the first repository will begin operations in 1998, and that the second will start up in 2004. However, it is recognized that both technical and institutional issues contribute to uncertainties concerning DOE's ability to complete one or more mined geologic repositories for high-level radioactive waste by those dates. The technical issues concern DOE's ability to find technically acceptable sites in a timely fashion and the timely development of waste forms, packages, and engineered barriers. The institutional issues concern primarily Federal-state relations and the management and funding of the Federal program.

The Commission has considered the effect of enactment of the Nuclear Waste Policy Act of 1982 and concludes that the Act helps to reduce these scheduling and institutional concerns. The Act provides support for timely resolution of technical uncertainties by: (1) Establishing specific milestones for all the key tasks; (2) coordinating the activities of all the involved Federal agencies; (3) providing for time schedules and a mission plan for the accomplishment of the tasks; and (4) providing a mechanism for monitoring progress, for identifying failures to meet the schedules and the milestones, and for adjusting the future elements of the program in the event that such failures occur. In order to further enhance the resolution of technical uncertainties regarding rock thermal-geomechanics the Act provides for the establishment of a Test and Evaluation facility to carry out *in-situ* studies of rock at repository depth. The Act also reduces uncertainties in the institutional arrangements for the participation of affected states in the siting and development of repositories and in the long-term management, direction and funding of the repository program. The Commission's assessment of both the technical and institutional factors is discussed below.

A. Technical Uncertainties

The ability to construct and operate a mined geologic repository that will provide for the safe disposal of high-level radioactive waste and spent fuel by the years 2007–09 has been challenged by several participants. In addition to the institutional issues which must be resolved, interrelated technical problems have to be solved in a coordinated and timely fashion. The Department of Energy is confident the technical problems can be solved as scheduled in the National Waste Terminal Storage Program plans (DOE PS p. III–86, CS p. III–13; DOE draft Mission Plan, April 1984). Other participants conclude that because of unresolved technical problems, DOE's schedule cannot be met (e.g., Consolidated Public Interest Group PHS pp. 2–7; Consolidated State Group PHS pp. 1–13). For convenience, we consider the technical controversy in two categories: (a) finding technically accceptable sites in a timely fashion, and (b) the timely development of waste packages and engineered barriers.

1. *Finding Technically Acceptable Sites in a Timely Fashion.* To assure the adequacy of a candidate site requires extensive onsite investigations including drilling or excavating, as well as analyses and technical evaluations. Although DOE has not yet begun subsurface site characterization to enable identification of an acceptable site, the record does indicate that DOE's site screening and selection program is providing information on site characteristics at a sufficiently large number and variety of sites and geologic media to support the expectation that one or more technically acceptable sites will be identified.

DOE is investigating four geologic media at a number of sites: domed salt (Gulf Interior Region); bedded salt (Paradox Basin, Permian Basin, Salina Basin); basalt (DOE's Hanford Site), and volcanic tuff (DOE's Nevada Test Site). Investigations in a fifth media (granite) are planned, but sites have not yet been determined (DOE PS Appendix B). Exploratory shaft excavation at three sites in different geologic media was to begin for basalt in April, 1983, for volcanic tuff in October, 1983, and for salt in December, 1983 (Tr. pp. 241–242). However, the Nuclear Waste Policy Act of 1982 (NWPA) imposed new conditions which made it necessary to revise this schedule. The NWPA specified that DOE had to prepare environmental assessments for each of five nominated sites, from which three sites would be recommended to the President for characterization. DOE's preparation of environmental assessments and recommendation of three sites were to be accomplished in keeping with the provisions of the repository siting guidelines required by the NWPA. The Commission's concurrence in DOE's siting guidelines on July 3, 1984, enables DOE to proceed to nominate and recommend repository sites for characterization. DOE has recently published a revised schedule for site selection milestones in its April, 1984 draft Mission Plan. As described in its Mission Plan, the current status of DOE's site selection schedule calls for the issuance of environmental assessments for five nominated sites and the recommendation of three of those sites for characterization by December, 1984. DOE's schedule for work in the various geologic media is summarized below.

Salt: Resolution of the identified key screening issues in FY 1984 is expected to permit nomination of a candidate salt dome site in December, 1984. DOE is still choosing from among several salt domes in the Gulf Coast interior region (Tr. pp. 243–244; DOE Draft Mission Plan, April, 1984). For bedded salt, primary effort has been focused on the Palo Duro Basin in Texas, the Paradox Basin in Utah, and the Permian Basin, particularly the Delaware basin in the Los Medanos area, the site considered for the proposed WIPP. The Bureau of Land Management issued the report "Environmental Assessment of DOE Proposed Location and Baseline Studies in the Paradox Basin, Utah-Final" UT–060–51–2–11, in July, 1982. Each of the seven potentially acceptable salt sites has been evaluated for environmental conditions, and a site characterization plan is expected to be issued for salt in September, 1985. DOE will start land access and permitting activities for salt after negotiating agreements with affected states and Indian tribes (DOE Draft Mission Plan, April, 1984).

Basalt: The basalt formations at the Hanford reservation in the center of the Pasco basin (Columbia Plateau, central Washington) are prime candidates for repository sites. DOE expects to issue a site characterization plan for basalt in January, 1985 and start drilling for the exploratory shaft in March, 1985 (DOE Draft Mission Plan, April 1984).

Volcanic Tuff: The Nevada Test Site offers several suitable candidates for

waste repository siting. The primary focus is welded tuff on Yucca Mountain, where DOE has begun a program of drilling and geophysical evaluation. DOE expects to issue site characterization plan for tuff in March, 1985 and begin shaft work in September 1985 (DOE Draft Mission Plan, April 1984).

Granite: Granite and other crystalline rock media are being considered for the second repository (DOE Draft Mission Plan, April 1984). DOE has conducted only limited investigations of granite at the Nevada Test Site (DOE PS pp. B–66, B–72), but is developing data on the potential of granite as a repository medium in collaboration with Swedish investigators (DOE PS p. II–258). This project has already produced a large amount of rock thermal-mechanics data at repository depth for use in repository designs in granite media in this county (DOE PS pp. II–258 to II–260).

As indicated in our discussion of technical feasibility, the identification of technically acceptable sites is a key problem and the date of successful solution of this problem is a critical milestone in the repository program. Those participants who believe DOE could not meet its site selection schedule asserted that determination of the acceptability of proposed repository sites requires information that will not be available when needed. They maintained that DOE's knowledge is seriously incomplete with respect to all of the potential sites considered to date. Further, they asserted that because new information could disqualify any of the potential sites, as it did at the Palestine dome, there is, as yet, no basis for reasonable assurance that an acceptable repository site will be available in the time period under consideration (NRDC PS p. 44; NECNP PS p. 24). The Commission recognizes that if the DOE program were further along, e.g., in the middle of exploratory shaft work, there would be much more site-specific information available (including the results of *in-situ* tests) and a firmer basis for assessing whether DOE's revised schedule can be met. However, the Commission can make a reasonable prediction with the information now before it.

Underlying the pessimism of some participants is apparently a belief that DOE's past record in solving technical problems undermines the possibility of finding confidence in DOE's ability to solve the waste disposal problems in a timely way. The Commission acknowledges that in the past the waste programs of DOE and its predecessor organizations have experienced difficulty in making timely progress toward a solution of the nuclear waste problem. However, the Commission need not rely on this past record in making its confidence determination. The DOE program is now adequately addressing the issues yet to be resolved in identifying an acceptable site and DOE's schedule is a reasonable one (see the discussion in Section 2.2 B.4 of this document). The qualifications and professional experience of the many scientists and engineers on the overview committees and peer review groups who advise and consult on the DOE program should provide confidence in DOE's efforts (DOE CS Appendix D). The support of the USGS in the earth sciences field (USGS PS Appendix A) clearly contributes to confidence that the technical problems associated with identifying an acceptable repository site will be solved. As noted before, no fundamental technical breakthroughs are necessary. Rather, completing the program is a matter of step-by-step evaluation and development based on ongoing site studies and research programs.

The Commission believes that the enactment of the Nuclear Waste Policy Act of 1982 provides impetus to that program and helps ensure that it will be completed on a schedule consistent with the Commission's findings. The Nuclear Waste Policy Act establishes a detailed step-by-step plan for developing a waste repository. The Act directs DOE to prepare a comprehensive Mission Plan which will establish programmatic milestones for research, development, technology demonstration and systems integration. The Act also requires the various Federal agencies involved in the program to coordinate their activities. Involved agencies must report their progress, or lack thereof, to Congress, explain any slip in schedule and set a new schedule for activities. Thus, the Act provides a framework and schedule for developing a repository.

The schedule set forth in the Act calls for the identification of adequate sites in time to meet the final decision date on construction authorization by the NRC and well before the time at which such action would be necessary to assure repository operation within the time period discussed in this decision. The time between sinking of an exploratory shaft and the completion of site characterization contemplated by the Act (Sec. 112, 114) is 26 months, with an extension to 38 months under certain conditions; the DOE schedule for these activities is generally compatible with this schedule (see Section 2.2 B.4 below).

The Nuclear Waste Policy Act also puts in place procedures (Sec. 115, 116, 117, 118, 119) which the Commission believes will help to resolve potential institutional problems that might affect the schedule for site selection. These are discussed in detail hereafter. The Commission believes that the provisions of the Act should also provide resources (Sec. 302, 303) to adequately fund the site selection and characterization work.

Given all of these considerations, the Commission concludes that there is reasonable assurance that technical uncertainties—unsolved technical problems and information gaps—will be removed in time for DOE to meet its proposed schedule. DOE's program is adequate and its schedule is reasonable. The Act provides a greater degree of confidence than existed previously that site selection will proceed within the general time frame that DOE has described in its position statement.

2. *Timely Development of Waste Packages and Engineered Barriers.* Some participants have expressed strong reservations concerning DOE's ability to develop waste forms, packages, and engineered barriers in a timely fashion. The DOE technical effort to solve problems was characterized as only just being defined in many significant areas, including the prevention of corrosion of waste canisters (NRDC PS p. 18). Other participants contended that: the design and evaluation studies of penetration seals and backfill material might not be completed soon enough to meet the goal of achieving an operational repository by 1997 to 2006; the long-term effects of heat and radiation on the integrity of the seal materials are not known; tests of cement seals with epoxy resin in bedded salt deposits are insufficient to assure stability of such seals over a period of 10,000 years; and field tests of liquid permeability during a period of three months cannot provide confidence concerning the stability of seals during a period of 10,000 years. Participants also contended that no information had yet been provided which specified the type of backfill material most suitable for specific geological media and capable of withstanding thermal stress (CDC PS pp. 19–22).

Although technical problems associated with the development of waste packages and engineered barriers could delay DOE's schedule, DOE believes that the uncertainties surrounding the waste package would be resolved or bounded as a result of implementation of its program (DOE PS p. II–160, CS p. II–96). The DOE Waste Package Program Plan (ONWI–96)

which was issued in August 1980, updated in June 1981 (NWTS–96) and updated further in DOE's April, 1984 Draft Mission Plan, sets forth details of DOE's program. Waste package performance criteria will be developed in the near future. Final action on the criteria will be contingent upon the final issuance of NRC's technical criteria (10 CFR Part 60, Subpart E), the publication of the relevant regulatory guides on waste packages, and the ONWI–33 series of criteria documents, i.e., the reports DOE/NWTS–33 (1), (2), (3), "NWTS Program Criteria For Mined Geologic Disposal of Nuclear Wastes."

Earlier, DOE had planned to complete the waste package preliminary designs for salt in September 1982, for basalt in June 1985, for tuff in June 1984, for granite in September 1984, and for argillaceous rock in December 1984, and to establish a baseline for waste form specifications by June 1983 (ONWI–96). According to DOE's April, 1984 draft Mission Plan, the current reference canister material for basalt is carbon steel. Alternative materials include an iron-chromium-molybdenum alloy, copper and a copper-nickel alloy. On the basis of preliminary corrosion-test results, carbon steel has also been selected as the reference canister material for salt. The titanium alloy Tricode 12 has been designated as an alternative material. Type 304L stainless steel has been identified as the reference container material for tuff; other austenitic stainless steels, Inconel and copper are alternatives. Waste-package conceptual designs have been developed for basalt, salt and tuff. (The conceptual design for tuff is based on saturated conditions; a conceptual design for the unsaturated zone will be available in late FY 84 [DOE draft Mission Plan, April 1984]).

Tests with spent fuel and borosilicate glass have been initiated under site-specific conditions for basalt, salt and tuff. Preliminary waste acceptance requirements have been developed for basalt and salt. In addition, for salt media, interim waste-acceptance requirements for borosilicate glass and draft waste acceptance requirements for spent fuel were prepared in FY 83. Preliminary requirements for tuff will be prepared in FY 84. DOE intends to submit the baseline waste form specifications developed during the conceptual design studies for acceptance by NRC. The specifications will be subjected to configuration control for application throughout the waste processing and disposal program.

According to the DOE Draft Mission Plan the complete waste package performance model will be verified and validated by September 1989. Further, the program plan calls for completion of the waste package final design that takes into account the selected site environmental conditions, after completion of in-situ testing in FY 89 and FY 90. Packing material is included in the reference waste package only for basalt. The reference packing material for basalt is a mixture of crushed basalt and sodium-bentonite clay. Ongoing physical property testing of reference packing material is expected to be completed in FY 87 and ongoing radionuclide sorption, solubility and diffusion testing are to be completed by September, 1989.

Some participants' statements are pessimistic assessments based on the fact that the DOE program has not yet reached the critical milestones—e.g., establishment of waste form specifications, completion of waste package preliminary designs, verification of a waste package performance model, and qualification of barrier materials. However, the Commission believes that these technical problems will be solved without delaying a repository schedule. DOE has put in place an extensive nuclear waste research program that addreses each of these technical problems. Research results already reported on waste form packaging and barrier materials indicate that these research efforts, although not yet completed, can reasonably be expected to provide solutions to those problems when those solutions are needed to meet the DOE schedule (DOE PS pp. II–129 to II–197, CS pp. II–93 to II–100).

The Commission's positive assessment is strengthened by provisions in the Nuclear Waste Policy Act of 1982. Title II of the Act authorizes DOE to undertake steps leading to the construction, operation and maintenance of a deep geologic test and evaluation facility and to establish a focused and integrated research, development and demonstration program. In the area of waste package design, the Act directs that DOE's Mission Plan identify a process for solidifying high-level radioactive waste or packaging spent fuel with an analysis of the data to support selection of the solidification process or packaging technique. The Act calls for a schedule for implementing such a plan and for an aggressive research and development program to provide a high-integrity disposal package at a reasonable price (Sec. 301(a)(8)). The Commission notes that DOE's published Draft Mission Plan (April, 1984) addresses these issues in detail. Congressional authorization of those programs, together with the assurance of necessary funding, provides the Commission additional confidence that the required research work will be done in a timely manner.

The Commission also notes that the programs to solve the major technical problems relating to the timely development of waste forms, waste packages, and engineered barriers can proceed in parallel. Because the waste repository must be designed as a system, the problems are interrelated; however, the relationships are such that solving one problem need not await the solution of another. DOE could proceed for a number of years on waste package development before making a decision on the form of the waste, without affecting the repository availability schedule.

B. Institutional Uncertainties

The principal institutional issues that affect the schedule for availability of a mined geologic repository include: measures for dealing with Federal-state disputes; an assured funding mechanism that will be sufficient over time to cover the period for developing a repository; an orginizational capability for managing the high-level waste program, whether this be DOE or a successor organization; and a firm schedule and establishment of responsibilities which will lead to repository development in a reasonable period of time. Each of these is discussed in turn.

1. *Measures for Dealing with Federal-State-Local Concerns.* The President and Congress have recognized the need to involve state and local governments in the decision-making process and have taken steps, including enactment of the Nuclear Waste Policy Act of 1982, to establish an institutional framework to accomplish this end. DOE pointed out that Presidents Carter and Reagan have considered state involvement in site selection an important aspect of the high-level radioactive waste disposal program. President Carter, in his message to Congress, directed "the Secretary of Energy to provide financial and technical assistance to States and other jurisdictions to facilitate full participation of State and local government in review and licensing proceedings." He committed the Federal Government to work with state, tribal and local governments in the siting of high level waste repositories. Within a framework of "consultation and concurrence," a host state would have a continuing role in Federal decision-making involving the siting, design and construction of a high-level waste

repository (DOE CS pp. II–11, 13–14). President Reagan's statement of October 8, 1981 similarly instructed DOE to work closely with industry and state governments in developing methods of storing and disposing of commercial high-level waste.

Although industry groups believed that DOE had made substantial progress in cooperating with state and local authorities by encouraging their direct participation in planning and preliminary site selection activities (UNWMG–EEI CS pp. V–27, V–28), states and environmental groups were skeptical that the mechanisms proposed by DOE for incorporating state and local views (e.g., consultation and concurrence) would work satisfactorily. Many states asserted a lack of confidence in DOE's claims that it would be able to gain agreement from states by persuasive measures (e.g. Ohio PS p. 5; NY PS p. 74; Wis PS Kelly p. 5) and noted that information sharing was inadequate to reduce or overcome a state's resistance to a repository (e.g., NY PS p. 74; NRDC PS p. 69). The states also believed that DOE had underestimated potential state and local opposition to the siting of a repository (CEC PS p. 27, Ohio PS p. 12) and that consultation and concurrence must include a mechanism for resolving intergovernmental disputes (Vt PS p. 3). Other participants argued that many states had already imposed bans on waste disposal (NECNP PS p. 32) and that DOE had presented no means for resolving state nonconcurrence (NRDC PS p. 69). Still others claimed that the state's role in the site selection process must be specifically defined (Del PS p. 6); but the DOE had provided no basis for optimism that this could be done (NECNP PS p. 69). Some participants suggested that local opposition to waste repositories could be overcome by providing financial compensation to nearby communities (AIChE PS p. 6) but that DOE had not adequately considered compensation to host communities for socioeconomic impacts (Ohio PS p. 14).

The recently-enacted Nuclear Waste Policy Act of 1982 defines the roles of the states and Indian tribes in repository site selection, and thereby reduces some of the uncertainties in settling disputes between the Federal government and affected states and Indian tribes. By providing for information exchange, for financial and technical assistance, and for processes of consultation, cooperation, negotiation and binding written agreement, the Act should help to minimize the potential for more formal objections and confrontations.

Specifically, the Act requires DOE to identify the states with one or more potentially acceptable sites for a repository and to notify the governing bodies of the affected states or Indian tribes of those sites (Sec. 116(a)). The Act establishes detailed procedures for consultation with the states and Indian tribes regarding repository sites selection (Sec. 117). DOE, NRC and other agencies involved in the construction, operation, or regulation of any aspect of a repository in a state must provide to the state and to any affected Indian tribe, timely and complete information regarding plans made with respect to the site characterization, development, design, licensing, construction, operation, regulation, or decommissioning of such a repository (Sec. 117(a)(1)). If DOE fails to provide such information requested by the state or affected Indian tribe in a timely manner, it must cease operations at the site (Sec. 117(a)(2)). The Act also provides that DOE must consult and cooperate (Sec. 117(b)) with the affected states and Indian tribes and must enter into a binding written agreement (Sec. 117(c)) setting forth the procedures under which information transfer, consultation and cooperation is to be conducted.

Following consultation with affected states and Indian tribes, the Secretary of Energy is to recommend to the President three sites suitable for characterization as candidates for selection as the first and second repositories (by July 1, 1985 and July 1, 1989 respectively) (Sec. 112(b), (B), (C)). The President must then submit to Congress his recommendation of sites qualified for construction authorization for a first and second repository (no later than March 31, 1987 and March 31, 1990 respectively) (Sec. 114(a)(2)(A)). Following submission by the President of a recommended site to Congress, the Governor or legislature of the state, or the Indian tribe in which such site is located may disapprove the site designation and submit (within 60 days) a notice of disapproval to Congress (Sec. 116(b)(2)). The site is disapproved unless Congress passes a joint resolution within 90 days to override the state or Indian tribe disapproval (Sec. 115 (c)). The Commission recognizes that the latter provision may create uncertainty in gaining the needed approvals of repository sites from the affected states or Indian tribes. Nevertheless, the Commission believes that, on balance, this Congressional action to establish a detailed process for state and tribal involvement in the development of repositories will reduce overall uncertainties by encouraging Federal-state cooperation and by limiting the potential for formal state or Indian tribe objections that could lead to disruption of project plans and schedules. This conclusion is consistent with the views expressed by state participants in this proceeding that a mechanism for state participation, including the resolution of state objections and nonconcurrences, is necessary for state cooperation and for progress in repository development (Tr. pp. 117, 119, 120). Further, the Act fixes the point in time at which a state may raise formal objections. Once that time has passed, this should reduce uncertainties at later stages.

The Act stipulates that DOE will reimburse costs incurred by affected states and Indian tribes in participating in the activities identified above. The Act provides that the Secretary of Energy shall make financial grants (Secs. 116, 118) to each state or affected Indian tribe notified by DOE that a potentially acceptable repository site exists within its jurisdiction. These grants are made to enable the state or affected Indian tribe to participate in the review and approval activities required by the Act (Secs. 116, 117), or authorized by written agreement entered into with DOE. Further, DOE is to make financial grants (Secs. 116, 118) to each state or affected Indian tribe where a candidate site for a repository is approved, to enable the state or Indian tribe to conduct the following activities: (a) Review activities taken for purposes of determining impacts of such a repository, (b) develop a request for impact assistance, (c) engage in site monitoring, testing or evaluation, (d) provide information to its residents, and (e) request information. In addition, the Act specifies that financial assistance will be provided to mitigate any economic, social, public health and safety, or environmental impacts of the development of a repository. The Act also provides that state and local government units shall receive payments equal to the amount they would receive from taxing such site charaterization and repository development activities in the same manner that they tax other real property and industrial activities (Sec. 116). By providing a tangible benefit to those localities or Indian reservations where repository sites are being investigated, this provision should address one concern frequently expressed by state and tribal organizations, and may result in a more willing acceptance of a repository site.

In sum, the Commission believes that the provisions of the Nuclear Waste

Policy Act of 1982 reduce uncertainties regarding the role of affected states and Indian tribes in repository site selection and evaluation, and minimize the potential for direct confrontation between the Federal government and the states or tribal organizations with respect to the disposal of commercial high-level waste and spent fuel. By reducing these uncertainties, the Act should help minimize the potential that differences between the Federal government and states or Indian tribes will substantially disrupt or delay the repository program. Further, as discussed previously in this Section, the decision-making process set up by the Act provides a detailed, step-by-step approach which builds in regulatory involvement. This should also provide confidence to states and Indian tribes that the program will proceed on a technically sound and acceptable basis.

2. *Continuity of the Management of the Waste Program.* The Commission recognizes that the waste disposal program involves activities conducted over a period of decades. Thus, there is a need for long-term stability of management and organization. The Commission's Second Prehearing Memorandum and Order of November 6, 1981, sought comments on the implications of the possible dismantling of the DOE and assignment of its functions to other Federal agencies. In response, DOE stated: "The ability of the Federal Government to implement the waste isolation program would not be affected by the President's September 24, 1981 proposal to dismantle DOE. As demonstrated by his Nuclear Policy Statement of October 8, 1981 the President is committed to the swift deployment of means of storing and disposing of commercial high-level nuclear waste. Thus, some governmental unit will continue the program aggressively if DOE is dismantled" (DOE PHS p. 8). The DOE statement was amplified by the Deputy Secretary of Energy in the oral presentations on January 11, 1982: " as far as the reorganization is concerned, the plan is not, I think, to do away with the activities of the Department of Energy. The plan, as it has been announced so far, is to in fact merge the activities, in particular, these activities into the Department of Commerce. And we do not visualize at this time any significant changes in the way in which the program relating to waste management would be altered, either technically or from a management point of view" (Tr. p. 13).

The nuclear industry participants agreed with DOE's view on this question (Consolidated Industry Group PHS p. 18; AIF PHS p. 7; SE2 PHS p. 6; ANS PHS p. 8, UG p. 2). However, state participants and intervenor groups disputed the DOE view. They saw the potential dismantlement of DOE as leading to further delay in resolution of the radioactive waste disposal problem and asserted that DOE's possible abolition made representations regarding the future success of its waste program useless (Consolidated State Group PHS, pp. 2, 9; Minn PHS pp. 6–8).

The Commission does not believe that the Administration's proposal to transfer the activities of the Department of Energy to the Department of Commerce introduces substantial new uncertainties regarding the continuity of Federal management of the nuclear waste program. As the Department of Energy stated, the Administration's proposal, if adopted, would simply transfer the nuclear waste program functions from one Federal agency to another. Moreover, Congressional action is needed to adopt the Administration's proposal. Yet, in the three years since the Administration's proposal to dismantle DOE was made, there has been no discernible action by the Congress to proceed with adoption of the proposal. Because the Congress has not taken action toward adoption of the Administration's proposal, and because the proposal, even if adopted, would consist of only a transfer of the program from one agency to another, the Commission does not believe that the Administration's proposal constitutes a significant source of management uncertainty for the nuclear waste program.

The Commission believes that residual uncertainties regarding the continuity of Federal management of the nuclear waste program have also been reduced by the Nuclear Waste Policy Act of 1982. The Act provides for the establishment of an Office of Civilian Radioactive Waste Management within the Department of Energy. This Office is to be headed by a Director appointed by the President, with Senate confirmation, who will report directly to the Secretary of Energy (Sec. 304). Further, the Act raises the activities of this Office to a high level of visibility and accountability by stipulating that an annual comprehensive report of the activities and expenditures of the Office will be submitted to Congress and that an annual audit of the Office will be conducted by the Comptroller General, who will report the results to Congress. The Act also requires two additional elements that provide added assurance of continuity: a "Mission Plan" and a schedule of activities for DOE. The Mission Plan is a detailed and comprehensive report which is intended to provide "an informational basis sufficient to permit informed decisions to be made in carrying out the repository program and the research, development, and demonstration programs required under this Act." The Secretary of Energy has already submited a draft Mission Plan to the states, the afffected Indian tribes, the Commission and appropriate government agencies for their comments; after revising the plan, DOE must submit it to the appropriate Congressional committees (Sec. 301 (a) and (b)). The schedule of DOE's activities in conducting this program was discussed in Section 2.2 A.1 above. Taken together, the provisions of the Nuclear Waste Policy Act establish a detailed management framework for the conduct of the repository program that should help ensure both sound management and continuity—whether the responsibility for the repository program is retained in DOE or is transferred to another Federal agency.

3. *Continued Funding of the Nuclear Waste Management Program.* There is general agreement among all participants that the program to develop a mined geologic repository for nuclear wastes will require more than a decade of effort at a total cost of several billion dollars. A steady source of funding will be needed to assure the timely success of the program. DOE pointed out that it would request an adequate level of funding for the National Waste Terminal Storage (NWTS) Program as stated in the Department's Position Statement (DOE CS p. II–30). In addition, DOE stated that Congress' commitment to the commercial waste disposal program was demonstrated by the continuous increase in the level of funding since 1976. The funding level was increasd by more than a factor of 10 between 1976 and 1980 (DOE CS p. II–30). Some participants disagreed with DOE's optimism concerning the future availability of funds and pointed out the competing priorities for Federal funds could deprive DOE of the necessary resources (CDC PS p. 7; Lewis PS p. 9; NRDC PS p. 28; Tr. p. 203).

Congress passed a continuing resolution for FY 1983 funding of DOE's nuclear waste program at the level of $259.4 million. This is about $10 million more than DOE's earlier FY 1983 request of $249 million. Additionally, the Nuclear Waste Policy Act authorizes the Secretary of Energy to enter into contracts and collect a fee of 1 mill per kilowatt-hour of electricity generated by nuclear reactors in return for the Federal

government's acceptance of title, subsequent transportation, and disposal of high-level radioactive waste or spent fuel (Sec. 302(a)(2)). In order to be able to use a Federal repository, the Act required the generator or owner of such waste or spent fuel to enter into a contract by June 30, 1983 or the date on which generation is commenced or title is taken, whichever occurs later (Sec. 302(b)(2)). The Commission must require the negotiation of such contracts as a precondition to the issuance or renewal of a license (Sec. 302(b)(1)(B)). The Commission notes that all such contracts have been executed. DOE testified in the January 11, 1982 hearing that it expected the funds collected under such a program would allow support of the DOE waste program at an initial level of $185 million. Under the program subsequently adopted by the Congress, these funds are to be placed into a nuclear waste fund to support DOE's repository program. The general approach prescribed by the Act is to operate DOE's nuclear waste program on a full cost recovery basis. In this regard, the Act provides that DOE must annually review the amount of the fees established to evaluate whether collection of the fees will provide sufficient revenues to offset the costs expected. In the event DOE determines that the revenues being collected are less than the amount needed in order to recover the costs, DOE must propose to Congress an adjustment to the fee to insure full cost recovery. The Act also provides (Sec. 302(e)(5)) that, if at any time, the monies available in the Waste Fund are insufficient to support DOE's nuclear waste program, DOE will have the authority to borrow from the Treasury. The Commission believes that the long-term funding provisions of the Act should provide adequate financial support for DOE's nuclear waste program.

4. *DOE's Schedule for Repository Development.* The DOE reference schedule described in its April, 1984 draft Mission Plan establishes the earliest date of repository availability as 1998 and delineates the logic and the period of activities that are deemed achievable under current program assumptions. While DOE acknowledges that contingency time is required in the schedule to accommodate such factors as institutional uncertainties, public hearings, or possible project reorientation, it believes that an appropriate amount of time has, in fact, been allowed in the reference schedule. Under the reference schedule, DOE expects that disposal facilities will be operational in 1998 (DOE draft Mission Plan, April 1984). DOE's updated repository development schedule specifies the critical milestones prior to commencing construction of the first repository as:

March 1985 (basalt), September 1985 (tuff), ——— (salt).	Commencement of exploratory shaft work* at three sites (three different media: salt, basalt and tuff).**
August 1990	Submission of application for authorization to construct the first repository.
August 1993	Construction authorization for the first repository.

* Including borehole drilling.

** An October, 1982 update of this information indicated that a pilot borehole was started in September 1982 for an exploratory shaft in tuff at the Nevada Test Site. In May 1982, DOE initiated work on surface preparation, construction of drilling pads and support buildings for the drilling operation at the BWIP basalt site. In January 1982, a borehole was begun at a point 300 feet from the BWIP planned exploratory shaft location to provide data for planning the shaft excavation. No exploratory shaft work has begun at the Paradox Basin bedded salt site. As noted in the siting discussion under the Second Commission Finding, the Nuclear Waste Policy Act of 1982 requires DOE to complete certain actions before site characterization. These include issuance of siting guidelines concurred in by NRC, preparation of environmental assessments, notification of state and affected Indian tribes where sites are located, and holding of public hearings in the vicinity of each site.

The Commission concurred in DOE's repository siting guidelines on July 3, 1984, enabling DOE to proceed to complete the other site selection tasks. The Commission notes that DOE's draft Mission Plan (April 1984) anticipated the completion of the siting guidelines by Mid-Summber 1984 and DOE revised its site selection schedule accordingly. Final environmental assessments for five nominated sites (including salt, basalt and tuff media) are to be completed in December 1984, at which time three of the five sites will be recommended for characterization.

NRC's construction authorization (under 10 CFR Part 60) would mark the end of the site selection process.

Some participants believe that DOE cannot have a waste disposal facility available by 2007 These participants concluded that DOE's slow progress in the past suggests that DOE may be unable to solve the many problems that will arise in the future and that DOE's schedule for repository development is unduly optimistic (e.g., Minn. PS p. 6; Ill. PS p. 2; OCTLA PS pp. 8–9; CDC PS p. 7).

One of the primary purposes of the recently enacted Nuclear Waste Policy Act of 1982 is "to establish a schedule for the siting, construction, and operation of repositories that will provide reasonable assurance that the public and the environment will be adequately protected from the hazards posed by high-level radioactive waste and such spent nuclear fuel as may be disposed of in a repository." (Sec. 111(b)(1)). The Commission recognizes that, if fundamental technical breakthroughs were necessary, it would not be possible for Congress to legislate their solution or specify schedules for their accomplishment. However, as discussed previously, such breakthroughs are not necessary. Rather, the remaining uncertainties are reflected in the need for step-by-step evaluation and development based on ongoing site studies and research programs. The Commission believes the Act provides means for resolution of those institutional and technical issues most likely to delay repository development, both because it provides an assured source of funding and other significant institutional arrangements, and because it provides detailed procedures for maintaining progress, coordinating activities and rectifying weaknesses. For these reasons, the Commission believes that the selection and characterization of suitable sites and the construction of repositories will be accomplished within the general time frame established by the Act, or within a few years thereafter.

The provisions of the Nuclear Waste Policy Act of 1982 that establish schedules for repository development are elaborate and allow for various contingencies. A number of steps are involved before NRC considers authorization of construction. DOE is to nominate five sites it believes suitable for site characterization for possible repository development (Sec. 112(b)). DOE is to recommend for site characterization three candidate sites to the President (Sec. 112(b)(1)(B); the President is to recommend one of the characterized sites to the Congress (Sec. 114(a)(2)(A)); the affected state or Indian tribe is given an opportunity to submit a notice of disapproval of the Congress (Secs. 115(b), (116)(b)(2), 118(a)); the Congress may overturn a state or Indian tribe's disapproval of the site by passing a resolution of approval (Sec. 115(c)); and, if Congress approves or no notice of disapproval is submitted by a state or Indian tribe, then DOE is to apply for construction authorization (Sec. 114(b).

DOE's revised reference schedule (DOE draft Mission Plan, April 1984) states that the application for repository construction authorization will be submitted to the Commission in August 1990. Under the terms of the Act the Commission is expected to reach a decision within 3 years of the application date, or by August 1993 (Sec. 114) (under certain conditions, extension by 1 year would be permitted). If the NRC decision is favorable, the repository would be constructed and begin operation, according to DOE's "reference schedule," in January 1998. Earlier dates can be achieved if the Presidential review time is reduced, if DOE promptly files the construction authorization application, if NRC provides a construction authorization in less than 3 years, or if DOE constructs the repository in a shorter period than provided in its estimated schedule. However, it is prudent to assume that

such a contraction of the schedule will not be realized.

The Nuclear Waste Policy Act of 1982 establishes "not later than January 31, 1998" as the date when DOE is to begin disposal of high-level radioactive waste or spent fuel (Sec. 302(a)(5)(B)). This is consistent with the current dates of the DOE schedules discussed above and with the detailed step-by-step milestones established by the Act. The schedule established by the Act would assure the operation of the first repository well before the years 2007–2009, i.e., the period of concern in the present proceeding.

Despite the delays in DOE's earlier milestones, the Commission believes that the program established by the Act is generally consistent with the schedule presented by DOE in this proceeding and that DOE's milestones are generally both realistic and achievable. Achievement of the scheduled first date of repository operation is further assured by other provisions of the Act which specify means for resolution of those institutional and technical issues most likely to delay repository completion. In addition to those provisions discussed previously, the Commission notes that the Act clarifies how the requirements of the National Environmental Policy Act are to be met (e.g., Secs. 113 (c), (d); 114 (a), (f); 119(a); 121(c)). The Act also requires that any Federal agency determining that it cannot comply with the repository decision schedule in the Act must notify both the Secretary of Energy and Congress, explaining the reasons for its inability to meet the deadlines. The agency must also submit recommendations for mitigating the delay (Sec. 114(e)(2)). These provisions of the Act, as well as those that support the technical program—the provisions for research, development, and demonstration efforts regarding waste disposal (Title II of the Act), increase the prospects for having the first repository in operation not later than the first few years of the next century.

The Commission also finds reasonable assurance that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of commercial high-level radioactive waste and spent fuel generated up to that time. The Nuclear Waste Policy Act of 1982 establishes Federal responsibility and a clearly defined Federal policy for the disposal of such waste and spent fuel and creates a Nuclear Waste Fund to implement Federal policy. The Act establishes as a matter of national policy that this responsibility is a continuing one, and provides means for the Secretary of Energy to examine periodically the adequacy of resources to accomplish this end.

The Commission notes that as of September 30, 1982, the generating capacity of all commercial nuclear power plants in the U.S. with operating licenses or construction permits was 131 electrical gigawatts (GWe) and the capacity of those under construction permit review was about 5 GWe (NUREG–0871, Vol 1, No. 4, p. 2, 8). DOE, in its letter of March 27, 1981 to the presiding officer of this proceeding, provided an estimate of 180 GWe for the capacity of operating LWRs in the year 2000. This value is significantly lower than the value (276 GWe) presented in DOE's 1980 position statement (DOE PS p. V–4) and lower than that (202 GWe) presented in the NRC's Generic Environmental Impact Statement on spent fuel handling and storage (NUREG–0575, Vol. 1, p. 2–4). The validity of the latter predictions has been affected by the cancellations of a number of proposed units during the past two years. The DOE 1981 estimate of 180 GWe in the year 2000 appears to be a reasonable estimate of the likely installed capacity at that time. On this basis, during the 40 years of operation of each plant, using as a realistic assumption a 60 percent capacity factor, the electrical energy generation would be about 4300 GWe-years. Assuming 38 metric tons of heavy metal (MTHM) is discharged for each gigawatt-year (IRG Final Report p. D–6; NUREG–0575, Vol. 1 p. 2–4) the total discharged spent fuel from these plants would likely be about 160,000 metric tons. The capacity of each proposed repository will depend on such factors as the thermal loading limit in waste emplacement, space limitations within the host rock, nuclear power generation capacity in the region to be serviced by the repository, and economy of scale considerations (DOE PS pp. III–70 to 79; IRG Final Report p. D–21). In its cross statement DOE's estimate that three to six repositories might be needed was based on the assumption that nuclear power generation capacity grows to 250 GWe by the year 2000 and remains at that level until 2040 (DOE CS p. II–53). The representative characteristics of each repository used by DOE were 2000 acres and a 40 to 100 kW/acre loading, corresponding to a repository capacity of about 70,000 to 170,000 metric tons of uranium, respectively (DOE PS p. III–76). Reflecting the reduction in nuclear power projections, DOE estimated in the January 1982 hearing that the ultimate reactor capacity would be about 200 GWe (Tr. p. 236). DOE then assumed a repository capacity of 100,000 metric tons and concluded that "between two and three" repositories would be needed (Tr. p. 237). To accommodate the 160,000 metric tons we have assumed, two repositories each with 100,000 metric tons capacity would appear to be sufficient.

Repository completion and operation at three-year intervals would result in having adequate capacity about three years after initial operation of the first repository (DOE PS p. III–86). As noted earlier, emplacement of spent fuel in the first repository should begin not later than the first few years of the next century. Thus, if the first repository begins to receive spent fuel in the year 2005, the second may begin operation as early as 2008, in which case all spent fuel would be emplaced by about 2026, assuming DOE's estimated receiving rates (DOE PS p. III–71) and operation of each repository as completed. Because the rate of waste emplacement during the first five years of operation would be about 1800 metric tons per year (DOE PS p. III–71), only 5400 metric tons would be emplaced in the first repository by the time the second began operation. This would satisfy the requirements of Section 114(d) of the Nuclear Waste Policy Act, i.e., the prohibition of emplacement of more than 70,000 metric tons in the first licensed repository before the second repository is in operation. If the DOE estimated emplacement rates (which would increase to 6000 metric tons/year after the first five years) are realized, it will take about 15 years to emplace 70,000 metric tons in the first repository.

For the foregoing reasons, the Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007–09, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of commerical high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

2.3 Third Commission Finding

The Commission finds reasonable assurance that high-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all high-level radioactive waste and spent fuel.

Nuclear power plants whose operating licenses expire after the years

2007–09 will be subject to NRC regulation during the entire period between their initial operation and the availability of a waste repository. The Commission has reasonable assurance that the spent fuel generated by these licensed plants will be managed by the licensees in a safe manner. Compliance with the NRC regulations and any specific license conditions that may be imposed on the licensees will assure adequate protection of the public health and safety. Regulations primarily addressing spent fuel storage include 10 CFR Part 50 for storage at the reactor facility and 10 CFR Part 72 for storage in independent spent fuel storage installations (ISFSI). Safety and environmental issues involving such storage are addressed in licensing reviews under both Parts 50 and 72, and continued storage operations are audited and inspected by NRC. NRC's experience in more than 80 individual evaluations of the safety of spent fuel storage shows that significant releases of radioactivity from spent fuel under licensed storage conditions are extremely remote (see discussion in Section 2.4).

Some nuclear power plant operating licenses expire before the years 2007–09. For technical, economic or other reasons, other plants may choose, or be forced, to terminate operation prior to 2007–09 even though their operating licenses have not expired. For example, the existence of a safety problem for a particular plant could prevent further operation of the plant or could require plant modifications that make continued plant operation uneconomic. The licensee, upon expiration or termination of its license, may be granted (under 10 CFR Part 50 or Part 72) a license to retain custody of the spent fuel for a specified term (until repository capacity is available and the spent fuel can be transferred to DOE under Sec. 123 of the Nuclear Waste Policy Act of 1982) subject to NRC regulations and license conditions needed to assure adequate protection of the public. Alternatively, the owner of the spent fuel, as a last resort, may apply for an interim storage contract with DOE, under Sec. 135(b) of the Act, until not later than 3 years after a repository or monitored retrievable storage facility is available for spent fuel. For the reasons discussed above, the Commission is confident that in every case the spent fuel generated by those plants will be managed safely during the period between license expiration or termination and the availability of a mined waste repository for disposal.

To assure the continuity of safe management of spent fuel, the Commission, in a separate action, is preparing an amendment to 10 CFR Part 50 which would require licensees of operating nuclear power reactors to submit, no later than 5 years before expiration of the reactor operating license, written notification to the Commission, for its review and approval, of the actions which the licensee will take to manage and provide funding for the management of all irradiated fuel at the reactor site following expiration of the reactor operating license, until ultimate disposal of the spent fuel in a repository. The licensee's notification will be required to specify how the licensee will fund the financial costs of extended storage or other disposition of spent fuel. It is possible for the funding of the storage to be provided by an internal reserve fund or special assessment during that 5-year period to cover the costs of storage of the spent fuel after the expiration of the reactor operating license. The storage costs are not large relative to power generation costs. A representative figure is $1-million/year for storage of spent fuel in reactor basins beyond the operating license expiration [Addendum 2 to "Technology, Safety and Costs of Decommissioning a Reference BWR Power Station," NUREG/CR 0130 (July 1983); Addendum 1 to Technology, Safety and Costs of Decommissioning a Reference PWR Power Station," NUREG/CR 0672 (July 1983)].

Additional assurance that the conditions necessary for safe storage will be maintained until disposal facilities are available is provided by the Commission's authority to require continued safe management of the spent fuel past the operating license expiration or termination (10 CFR 50.82). If a utility should have technical problems in continuing its commitment to maintain safe storage of its spent fuel, NRC as the cognizant regulatory agency would intervene and the utility would be required to assure safe storage. If a licensee fails financially, or otherwise must cease its operations, the cognizant state public utility commission would be likely to require an orderly transfer to another entity. The successor would take over the licensee's facilities and, provided the conditions for transfer of licenses prescribed in NRC regulations (10 CFR 50.80) were met by the succeeding entity, operation of the original licensee's facilities would be permitted to continue. Moreover, an orderly transfer to a successor organization would be mandatory to protect the substantial capital investment. Further, the Commission believes that the possibility of a need for Federal action to take over stored spent fuel from a defunct utility or from a utility that lacked technical competence to assure safe storage is remote, but the authority for such action exists (sections 186c and 188 of the Atomic Energy Act of 1954, as amended; 42 U.S.C. 2236, 2238).

Interim storage capacity may be required for plants whose operating licenses expire or are terminated before sufficient repository capacity is available. As discussed in the rationale for the fifth finding, the Nuclear Waste Policy Act of 1982 includes a number of provisions to assure the availability of interim storage capacity for spent fuel during the period before repository operation (Secs. 131 through 137). Provisions are made for Federal government supplied interim storage capacity (up to 1900 metric tons) for civilian power reactors whose owners cannot reasonably provide adequate storage capacity.

In all cases where the interim storage is at a licensee's site, safe management will be assured by compliance with NRC regulations and specific license conditions. Where DOE provides the interim storage capacity, except in the use of existing capacity at Government-owned facilities, DOE is to "comply with any applicable requirements for licensing or authorization" (Sec. 135(a)(4)). If existing federally-owned storage facilities are used, NRC is required to determine "that such use will adequately protect the public health and safety" (Sec. 135(a)(1)). These provisions of the Act would assure that spent fuel will be managed in a safe manner until repository capacity is available. Facilities for reprocessing high-level waste, should any be constructed or become operational before a repository is available, would be licensed under 10 CFR Part 50, and solidification and interim storage of high level waste would be provided for at such facilities. For the foregoing reasons, the Commission finds reasonable assurance that high-level waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available for its safe disposal.

2.4 Fourth Commission Finding

The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license at that

reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

Although the Commission has reasonable assurance that at least one mined geologic repository will be available by the years 2007–09, the Commission also realizes that for various reasons, including insufficient capacity to immediately dispose of all existing spent fuel, spent fuel may be stored in existing or new storage facilities for some periods beyond 2007–09. The Commission believes that this extended storage will not be necessary for any period longer than 30 years beyond the term of an operating license. For this reason, the Commission has addressed on a generic basis in this decision the safety and environmental impacts of extended spent fuel storage at reactor spent fuel storage basins or at either onsite or offsite spent fuel storage installations. The Commission finds that spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of reactor operating licenses. To ensure that spent fuel which remains in storage will be managed properly until transferred to DOE for disposal, the Commission is proposing an amendment to its regulations (10 CFR Part 50). The amendment will require the licensee to notify the Commission, five years prior to expiration of its reactor operating license, how the spent fuel will be managed until disposal.

The Commission's finding is based on the record of this proceeding which indicates that significant releases of radioactivity from spent fuel under licensed storage conditions are highly unlikely. It is also supported by the Commission's experience in conducting more than 80 individual safety evaluations of storage facilities.

The safety of prolonged spent fuel storage can be considered in terms of four major issues: (a) The long-term integrity of spent fuel under water pool storage conditions, (b) structure and component safety for extended facility operation, (c) the safety of dry storage, and (d) potential risks of accidents and acts of sabotage at spent fuel storage facilities. Each of these issues is discussed separately below, in light of the information provided by the participants in this proceeding, and NRC experience in regulating storage of spent fuel.

A. Long-Term Integrity of Spent Fuel Under Water Pool Storage Conditions

The Commission finds that the cladding which encases spent fuel is highly resistant to failure under pool storage conditions. As noted by DOE in its Position Statement, there are up to 18 years of continuous storage experience for zircaloy-clad fuel and 12 years continuous storage experience for stainless-clad fuel (DOE PS p. IV–73). Corrosion studies of irradiated fuel at 20 reactor pools in the United States suggest that there is no detectable degradation of zircaloy cladding. Data from corrosion studies of spent fuel stored in Canadian pools also support this finding (A.B. Johnson, Jr., "Behavior of Spent Nuclear Fuel in Water Pool Storage," (UC–70) Battelle Pacific Northwest Laboratories (BNWL–2256, September, 1977) pp. 10–11, 17).

The long-term integrity of spent fuel in storage pools, which has been confirmed by observation and analysis, was cited by industry participants (e.g., Consolidated Industry Group: PHS pp. 3–6; UNWMG–EEI PS Doc. 4, p. 8; UG p. 2). No degradation has been observed in commercial power reactor fuel stored in onsite pools in the United States. Extrapolation of corrosion data suggests that only a few hundredths of a percent of clad thickness would be corroded after 100 years (A.B. Johnson, Jr., "Utility Spent Fuel Storage Experience," PNL–SA–6863, presented at the American Nuclear Society's Executive Conference on Spent Fuel Policy and its Implications, Buford, Georgia (April 2–5, 1978). The American Nuclear Society cited a study (G. Vesterbend and T. Olsson, BNWL–TR–320, May 1978, English Translation of RB78–29), which concluded that degradation mechanisms such as general corrosion, local corrosion, stress corrosion, hydrogen embrittlement, and delayed hydrogen cracking are not expected to produce degradation to any significant extent for 50 years (ANS PS p. 34).

Canadian experience, including occasional examination during 17 years of storage, has indicated no evidence of significant corrosion or other chemical degradation. Even where the uranium oxide pellets were exposed to pool water as a result of prior damage of the fuel assembly, the pellets have been inert to pool water, an observation also confirmed by laboratory studies ("Canadian Experience with Wet and Dry Storage Concepts," presented at the American Nuclear Society's Executive Conference on Spent Fuel Policy and Its Implications, Buford, Georgia (April 2–5, 1978)). Another Canadian study concluded that "50 to 100 years under water should not significantly affect their [spent fuel bundles] integrity" (Walker, J.F., "The Long-Term Storage of Irradiated CANDU Fuel Under Water," AECL–6313 Whiteshell Nuclear Research Establishment, January 1979). This appraisal was based on findings such as no deterioration by corrosion or mechanical damage during 16 years of storage in water, no release of fission products from the uranium dioxide matrix during 11 years of storage in water, and no fission-product induced stress corrosion cracking anticipated during water storage at temperatures below 100°C (Hunt C.E.L., J.C. Wood and A.S. Bain, "Long-Term Storage of Fuel in Water" AECL–6577, Chalk River Nuclear Laboratories, June 1979).

The ability of spent fuel to withstand extended water basin storage is also supported by metallurgical examination of Canadian zircaloy clad fuel after 11 years of pool storage, metallurgical examination of zircaloy clad PWR and BWR high burn-up fuel after five and six years in pool storage, and return of Canadian fuel bundles to a reactor after 10 years of pool storage. Periodic hot cell examination of high burn-up PWR and BWR bundles over 6 years of pool storage at the WAK Fuel Reprocessing Plant in Germany has also confirmed that spent fuel maintains integrity under pool storage conditions. Other countries having favorable experience with pool storage of zircaloy-clad spent fuel include: the United Kingdom, 13 years; Belgium, 12 years; Japan, 11 years; Norway, 11 years; West Germany, 9 years; and Sweden, 7 years (op. cit., A. B. Johnson, Jr., p. 7). Programs of monitoring spent fuel storage are being conducted in Canada, the United Kingdom and the Federal Republic of Germany (DOE PS pp. IV—59 to IV–61; UNWMG–EEI PS Doc. 4, p. 23).

The only fuel failures which have occurred in spent fuel pools involved types of fuel and failure mechanisms not found at U.S. commercial reactor facilities, e.g., degradation of zircaloy-clad metallic uranium fuel from the Hanford N-Reactor as a result of cladding damage in the fuel discharge system. The system differs from the fuel discharge systems of commercial reactors. Moreover, metallic uranium fuel is not used in commercial power reactors. NRDC cited some conclusions drawn by Mr. Justice Parker regarding his lack of confidence in long-term storage of spent fuel, based on the Windscale Inquiry in Great Britain in 1978, which involved stainless-steel-clad gas-cooled reactor fuel (NRDC PS p. 92). This is not pertinent to pool storage of commercial spent fuel since the high temperature conditions in a gas-cooled reactor which can cause sensitization of the cladding are not experienced by fuel in boiling or pressurized water reactors (op. cit., A.B. Johnson, Jr., pp. 17–18).

Some participants did not agree that there is an adequate basis for

confidence in safe extended-term spent fuel storage. Although agreeing with the extent of experience cited by DOE and other participants, the Natural Resources Defense Council, for example, stressed that more experience is needed before one can be confident of safe extended storage. NRDC considered the length of storage experience cited by DOE as insufficient to establish that spent fuel can be stored safely for periods well in excess of 40 years (NRDC PS pp. 88–92). A similar position was taken by the State of Minnesota (Minn PHS pp. 8–9). NRDC referred to the problem of the long-term storage of spent fuel reported in the Windscale Inquiry Report by the Hon. Mr. Justice Parker, Vol. 1, pp. 29–30. However, the conclusion quoted from the report, when taken in context, refers only to irradiated fuel from AGR (advanced gas-cooled) nuclear power plants. As noted earlier, the conditions to which the fuel cladding is exposed in gas-cooled reactors differs from those in U.S. commercial light water reactors. Moreover, the cladding of AGR fuel is identified as stainless steel in the Windscale Inquiry Report. Only two commercial LWR nuclear power plants operating in the U.S. today use stainless steel clad. Most U.S. nuclear fuel is zircaloy clad, and reactor operators have not seen evidence of degradation of LWR spent fuel, either zircaloy or stainless steel clad, in storage pools *(Nuclear Technology,* "Spent Fuel Storage Experience," A.B. Johnson, Jr., p. 171, Vol. 43, Mid-April 1979). Further, as stated earlier, cladding degradation caused by stainless steel sensitization in an AGR high temperature environment is not pertinent to the lower temperature environment of LWR's. Therefore, the problem of long-term storage of spent fuel reported in the Windscale Inquiry is not relevant to U.S. spent fuel.

After expiration of a reactor operating license, the fuel storage pools at the reactor site would be licensed under 10 CFR Part 72. The requirements of 10 CFR Part 72 provide for operation under conditions involving a careful control of pool water chemistry to minimize corrosion. The required monitoring of the pool water would provide an early warning of any problems with defective cladding, so that corrective actions may be taken. Experience indicates that, under licensed storage conditions, significant releases of radioactivity are highly unlikely. The Commission is confident that the regulations now in place will assure adequate protection of the public health and safety and the environment during the period when the spent fuel is in storage ("Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel," NUREG–0575, August 1979: Vol. 1, pp. ES–12, 4–10 to 4–17).

Although confidence that spent fuel will maintain its integrity during storage for an additional 30 years beyond the facility's license expiration date involves an extrapolation of experience by a factor of two or three in time, the extrapolation is made for conditions in which corrosion mechanisms are well understood. Technical studies cited above support the conclusion that corrosion would have a negligible effect during several decades of extended pool storage. The Commission finds that this extrapolation is reasonable and is consistent with standard engineering practice.

B. Structure and Component Safety for Extended Facility Operation For Storage of Spent Fuel in Water Pools

Questions were raised concerning the adequacy of structural materials and components of spent fuel storage basins to function effectively during periods that are double those assumed in the base design. This concern was expressed in connection with the possible necessity for longer storage times if permanent disposal is not available by the year 2006 (Del PS p. 4). The experience at the General Electric Company Morris Operation in Illinois, where a mechanical failure caused contaminated water to leak into the environment, was cited as an example of an unforeseen failure that could jeopardize the safety of spent fuel storage (NECNP PS p. 65). A generic problem regarding pipe cracks in borated water systems at PWR plants was also cited as evidence of uncertainty that long-term interim storage would be safely accomplished without modification and fuel shuffling NECNP PS p. 64). The Commission notes that the latter problem was discussed in detail in the Atomic Safety and Licensing Board Notification, "Pipe Cracks in Stagnant Borated Water Systems at PWRs" dated August 14, 1979, in the ASLB consideration of a proposed licensing amendment to permit modification of a spent fuel storage pool [11 NRC 245 (1980)]. The Notification referred to by NECNP indicated that cracks had occurred in safety-related type-304 stainless steel piping systems which contained stagnant borated water. Apparently, the cracking was attributable to stress corrosion caused by the residual welding stresses in heat-affected zones. The NRC staff review found that such cracking was not directly related to spent fuel pool modifications, and that necessary repairs could be readily made. The staff concluded that cracks in low-pressure spent fuel cooling system do not have safety significance.

Extensive experience with storage pool operation has demonstrated the ability of pool components to withstand the operating environment (DOE CS pp. II–145 to II–148). In the relatively few cases of equipment failure, pool operators have been able to repair the equipment or replace detective components promptly (UNWMG–EEI PS Doc. 4, p. 25; UG p. 2). The Commission finds no reason why spent fuel storage basins would not be capable of performing their cooling and storage functions for a number of years past the design-basis period of 40 years if they are properly maintained.

As one participant pointed out," . . . the pool structure as well as the racks are designed to withstand extreme physical conditions set forth in NRC licensing requirements. These include seismic, hydrologic, meteorological and structural requirements" (UNWMG–EEI PS Doc. 4 p. 25; UG p. 2). The design requirements are set forth in 10 CFR Parts 50 and 72. The design-basis siting conditions for storage pools at reactor sites are those of the reactor itself. Siting conditions are reviewed by the NRC staff, the Advisory Committee or Reactor Safeguards and the Atomic Safety and Licensing Board at the construction permit stage and then reviewed again in connection with the issuance of the facility's operating license. In issuing a power reactor operating license, the Commission is, in effect, expressing its confidence that the design-basis siting conditions will not be exceeded during the 40-year license period. If pool storage facilities were used to store spent fuel after expiration of reactor operating licenses, the utilities would be able, as part of their continuing maintenance of storage facilities, to replace defective components in a timely way, if needed, so as to avoid any safety problems. Some participants (e.g., NECNP PS pp. 63–63; Minn PHS pp. 8–9; and Del PS p. 4), do not place the same weight which the Commission does on experience at spent fuel storage facilities and on studies cited by DOE and certain others which support the argument that the structural integrity of these basins can be readily maintained (DOE CS pp. II–145, III–13; UNWMG–EEI PS Doc. 4 p. 19). The disagreements appear to center largely on the extent to which present experience may be relied upon as a basis for predicting the safety of spent

fuel storage over a period two or three times the design period.

The degradation mechanisms involved in spent fuel pool storage are well understood. The resulting changes in fuel cladding and pool systems and components are gradual and thus provide sufficient time for the identification and development of remedial action without subjecting plant personnel or the public to significant risk. The fuel storage racks are designed to maintain their integrity for many decades; if they fail in any way, they may be replaced. There are a number of routine and radiologically safe methods for maintenance at spent fuel storage basins to ensure their continued effective performance. These include replacing racks or other components, or moving spent fuel to another storage facility. The Commission finds that the extensive operating experience with many storage pools adequately supports predictions of long-term integrity of storage basins.

The Commission concludes that the experience with spent fuel storage provides an adequate basis for confidence in the continued safe storage of spent fuel in water pools either at or away from a reactor site for at least 30 years after expiration of the plant's license.

C. Safety of Dry Storage of Spent Fuel

While the record of this proceeding has focussed on water pool storage, the Commission notes that dry storage of spent fuel has also been addressed to a limited extent (e.g., DOE PS pp. IV–12 to IV–22 and IV–63 CS p. II–147, PHS p. 9; UNWMG–PS Doc 4 pp. 16–17 and CS pp. III–6–7; Tr. pp. 69–72). The NRC's regulation 10 CFR Part 72 specifically covers dry storage of spent fuel (Section 72.2(c)), and experience with dry storage was a subject of public comment in the rulemaking ("Analysis of Comments on 10 CFR Part 72," NUREG–0587, pp. II–12 to II–13). NRC reports, the "Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel" (NUREG–0575) and "Dry Storage of Spent Nuclear Fuel, A Preliminary Survey of Existing Technology and Experience" (NUREG/CR–1223) which have been referenced in this proceeding, examined potential environmental impacts and experience with interim dry storage of spent fuel. The GEIS (Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel, NUREG–0575, Vol. 1, p. 8–2, August 1979) contained the conclusion that the use of alternative dry passive storage techniques for aged fuel, now being investigated by the Department of Energy, appears to be as feasible and environmentally acceptable as storage of spent fuel in water basins. Prior to the adoption of Part 72, dry storage of irradiated fuel had been licensed under Part 50 at the Hallam sodium graphite reactor. Dry storage is also presently licensed under Part 50 at the Ft. St. Vrain high temperature gas reactor.

Although the number of years of experience with dry storage systems is less than that with water pool storage, the understanding of some of the material degradation processes experienced in water pool storage should be applicable to dry storage. As discussed below, dry storage involves a simpler technology than that represented by water basin storage systems.[5] Water basin storage relies upon active systems such as pumps, renewable filters, and cooling systems to maintain safe storage. Favorable water chemistry must also be maintained to retard corrosion. On the other hand, dry storage reduces reliance upon active systems and does not need water which together with impurities may corrode spent fuel cladding. With convective circulation of an inert atmosphere in a sealed dry system, there is little opportunity for corrosion.[6] For these reasons, the Commission believes that safe dry storage should be achievable without undue difficulty. New dry storage experience with light water reactor (LWR) fuel is becoming available for examination, and the evaluations discussed below suggest that the favorable results of up to almost two decades of dry storage experience with non-LWR spent fuel can also be obtained for LWR spent fuel in adequately designed dry storage installations.

A recent review of dry storage experience by A.B. Johnson, Jr., et al. in "Behavior of Spent Nuclear Fuel and Storage Components in Dry Interim Storage" (PNL–4189, August 1982), provides an update of dry storage activities, particularly with respect to zircaloy-clad spent fuel. In this report, (pp. 18–24) the experimental data base for non-zircaloy-clad spent fuel, including stainless steel clad fuel and the data base for zircaloy-clad fuel are discussed. Tests conducted to verify the integrity of zircaloy cladding have not indicated any degradation in dry storage (p. 27). In summary, the report states (pp. 44–45):

> Operating information is available from fueled dry well, silo, vault, and metal cask storage facilities. Maximum operational histories are:

	All fuel	Zircaloy-clad fuel
Dry wells	Up to 18 years	Up to 3 to 4 years.
Vaults	Up to 18 years	Up to 1 year.
Silos	Up to 7 years	Up to 7 years.
Metal casks		<1 year.

All times related to 1982.

> Operational history with interim storage in metal casks is minimal; however, there is extensive experience with metal shipping casks. In addition, metal storage casks have been designed and tested, and cask tests with irradiated fuel are currently under way in the Federal Republic of Germany and are planned in Switzerland and the United States. The integrity of zircaloy-clad fuel in a given demonstration test is relevant to predicting fuel behavior in other dry storage concepts under similar conditions.

Information on experience with dry cask storage in other countries is also becoming available. K. Einfeld and J. Fleisch's paper, "Fuel Storage in the Federal Republic of Germany" discussed the results of dry storage research on spent fuel in an inert atmosphere. They note on page 3 of their report:

> Several tests have been conducted to verify the integrity of LWR spent fuel cladding in dry storage. To date none of the integrity tests has indicated that the cladding is degrading during long-term storage. Even under conditions more severe than in the casks, the fuel shows no cladding failures. From the tests listed in Table II it can be concluded that dry storage under cask conditions even with starting temperatures to 400° C is not expected to cause cladding failures over the interim storage period.

Einfeld and Fleisch continue, in their report (pp. 3–4) to comment on the successful demonstration of cask storage:

> A technical scale demonstration program with a fuel CASTOR cask is underway in the FRG since March 1982. The 16 assemblies which are subject to that program originate from the Wurgassen boiling water reactor. They resided in the core during 4 cycles of operation, burning up to about 27.8 GWD/t U.
>
> The general objectives of the demonstration with a fully instrumented cask and fuel bundles are the verification of cask design parameters, the operational experience in cask handling and the expansion of the data base on fuel performance. Fig. 2 shows a schematic

[5] See, for example, K. Einfeld and J. Fleisch, "Fuel Storage in the Federal Republic of Germany; and R.J. Steffen and J.R. Wright, "Westinghouse Advanced Energy Systems Division," Proceedings of the American Nuclear Society's Topical Meeting on Options for Spent Fuel Storage, in Savannah, Georgia, September 26 through 29, 1982; also A.B. Johnson, Jr., E.R. Gilbert, and R.J. Guenther, "Behavior of Spent Nuclear Fuel and Storage System Components in Dry Interim Storage," PNL–4189, August 1982.

[6] K. Einfeld and J. Fleisch, Ibid, p. 3.

drawing of the cask design and the axial thermocouple locations.

The operational experiences and corresponding test data confirm the assumptions made about the cask concept and the cask loading and handling procedure. In addition, the technology data base for operating an interim storage plant could be expanded.

—In-pool loading of a large storage cask and specific cask handling has been successfully demonstrated.
—The passive heat transfer capabilities of the cask and fuel cladding integrity have been verified. The maximum local fuel rod temperatures for fuel with about one year decay time were within the expected range.
—The total radiation shielding characteristics (<10 mrem/h) are verified in practice" (references deleted).

The authors conclude:

The realization of the transport/storage cask concept, which is well under way in the Federal Republic of Germany, will provide sufficient interim spent fuel storage capacity with the facilities planned or under construction. Dry interim storage is a proven technology and thus it constitutes an essential step in closing the backend of the nuclear fuel cycle.

R.J. Steffens and J.B. Wright's paper [7], "Drywell Storage Potential," discussed drywell storage experience with pressurized water reactor spent fuel at the Nevada Test site. On page 6 of the paper, the authors note:

Another drywell performance assessment method being employed during the demonstration storage period is that of periodically monitoring the storage canister atmosphere for fission products, specifically krypton-85 gas. Samples drawn to date have shown no detectable concentrations of this product after approximately 3 years of storage, indicating a maintenance of the fuel cladding integrity.

A third paper presented at the same Topical Meeting, by E.R. Gilbert and A.B. Johnson, Jr., "Assessment of the Light-Water Reactor Fuel Inventory for Dry Storage," focuses on dry spent fuel storage with respect to an acceptable temperature range for storage in air. They conclude on page 8 of their report:

Dry storage demonstrations now in progress suggest that by 1986 a major fraction of the U.S. PWR spent fuel inventory that was placed in water storage before 1981 can be stored in dry storage facilities below 150 to 200 °C.

The LWR fuel inventory offers good prospects that the thermal characteristics of consolidated fuel will be acceptable for dry storage by proper selection of fuel.

Dry storage of LWR fuel with defective cladding may be tolerable in inert cover gases or at temperatures below the threshold for significant oxidation in oxidizing cover gases. The range of acceptable storage temperatures is being investigated.

With respect to dry storage of spent fuel, the Commission notes the summary statement from A.B. Johnson, Jr., et al., "Behavior of Spent Nuclear Fuel and Storage Components in Dry Interim Storage" (PNL-4189), page xvii:

Operational problems in vaults and dry wells have been minor after up to 18 yr. of operation (in 1982); and 7 yr of silo experience suggests that decades of satisfactory operation can be expected. Demonstration tests with irradiated fuel in metal storage casks are just beginning, but metal shipping casks with mild steel chambers have been used since the mid-1940s. Metal storage/shipping casks have successfully survived fire, drop, and crash tests.

Thus, with respect to the storage of spent fuel under dry conditions at storage installations located either at reactor sites or away from reactor sites, the Commission believes that current dry-storage technology is capable of providing safe storage for spent nuclear fuel. The modular character of dry storage installations enhances the ability to perform maintenance or to correct mechanical defects, if any should occur. The Commission is confident that its regulations will assure adequate protection of the public health and safety and the environment during the period when the spent fuel is in storage.

The Commission notes that section 211(2)(B) of the Nuclear Waste Policy Act authorizes the Secretary of Energy to carry out research on, and to develop facilities to demonstrate, dry storage of spent nuclear fuel. Although this provision indicates a judgment on the part of the Congress that additional research and demonstration is needed on the dry storage of spent fuel, the Commission believes the information discussed above is sufficient to reach a conclusion on the safety and environmental effects of extended dry storage. All areas of safety and environmental concern (e.g., maintenance of systems and components, prevention of material degradation, protection against accidents and sabotage) have been addressed and shown to present no more potential for adverse impact on the environment and the public health and safety than storage of spent fuel in water pools.

The technical studies cited above support the conclusion that corrosion would have a negligible effect during several decades of extended dry storage. The Commission's confidence in the safety of dry storage is based on an understanding of the material degradation processes, rather than merely on extrapolation of storage experience—together with the recognition that dry storage systems are simpler and more readily maintained. For these reasons, the Commission is confident that dry storage installations can provide continued safe storage of spent fuel at reactor sites for at least 30 years after expiration of the plant's license.

D. Potential Risks of Accidents and Acts of Sabotage at Spent Fuel Storage Facilities

The Commission finds that the risks of major accidents at spent fuel storage pools resulting in off-site consequences are remote because of the secure and stable character of the spent fuel in the storage pool environment, and the absence of reactive phenomena—"driving forces"—which may result in dispersal of radioactive material. Reactor storage pools and independent spent fuel storage installations have been designed to safely withstand accidents caused either by natural or man-made phenomena. Even remote natural risks such as earthquakes and tornados and the risks of human error such as in handling or storing spent fuel are addressed in the design and operational activities of storage facilities and in NRC's licensing reviews thereof under its regulations. Under 10 CFR Parts 50 and 72, spent fuel is stored in facilities structurally designed to withstand accidents and external hazards, such as those cited above, and to preclude radiation and radioactive material emissions from spent fuel that would significantly endanger the public health and safety. In order to preclude the possibility of criticality under normal or accident conditions, the spent fuel is stored in racks designed to maintain safe geometric configurations under seismic conditions. The spent fuel itself consists of solid ceramic pellets which are encapsulated in metal clad rods held in gridded assemblies and stored underwater in reinforced concrete structures or in sealed dry storage installations such as concrete dry wells, vaults and silos or massive metal casks. The properties of the spent fuel (which in extended storage has decayed to the point where individual fuel assemblies have a heat generation rate of several hundred watts or less) and of the benign storage environment result in spent fuel storage being an activity with very little potential for

[7] Proceedings of the American Nuclear Society's Topical Meeting on Options for Spent Fuel Storage, in Savannah, Georgia, September 26 through 29, 1982.

adversely affecting the environment and the public health and safety. While any system employing high technology is subject to some equipment breakdowns or accidents, water pool storage facilities have operated with few serious problems (DOE PS at IV–56 to IV–57; UNWMG–EEI PS Doc. 4 p. 26). In these cases, the events at spent-fuel pools have been manageable on a timely basis. Similarly, dry storage of spent fuel, as discussed in Section C above, appears to be at least as safe as water pool storage. A discussion of risks related to spent fuel storage is provided below.

Comments from participants on the subject of accidents and their potential consequences at spent-fuel storage facilities included a description of nonspecific references to numerous "accidents" in spent-fuel storage facilities, a discussion of cases of leaks and inadvertent releases of contaminated storage pool water, and a suggestion that waste storage should be physically separated from reactor operation to reduce the risk of damage to the storage facility in the event of a reactor accident, and vice versa (NY PS pp. 102–107; OCTLA PS p. 12). The State of New York, in its discussion of possible accidents at spent-fuel storage pools, cited reports of an accident in the Soviet Union that is believed to have involved reprocessing plant wastes stored in tanks at a waste storage facility (NY PS pp. 107–108). The situation, as reconstructed from limited data, cannot be compared to the storage of ceramic fuel in metal cladding, placed in water storage pools. The issue raised, therefore, is not relevant to this proceeding. The need for continued management of pool storage facilities over an extended time period was considered by some participants as creating a potential hazard because of the increased possibility of human errors or mismanagement (NRDC PS pp. 89–90). The State of New York characterized the Three Mile Island reactor accident as caused by multiple technical and human failures, and postulated that such failures are possible at storage facilities, and would result in serious off-site consequences (NY PS p. 107).

These observations do not appear to take account of the numerous safety analyses that have been made of water pool storage and of alternative long-term storage methods which have demonstrated storage to be both safe and environmentally acceptable. Of course, the possibility of human error cannot be completely eliminated. However, Commission regulations (e.g., 10 CFR Part 55; 10 CFR Part 72, Subpart I) include explicit requirements for operator training, the use of written procedures for all safety-related operations and functions in the plant, and certification or licensing of operators, with the objective of minimizing the opportunity for human error. Unlike the accident at the Three Mile Island reactor, human error at a spent fuel storage installation does not have the capability to create a major radiological hazard to the public. The absence of high temperature and pressure conditions that would provide a driving force essentially eliminates the likelihood that an operator error would lead to a major release of radioactivity (DOE CS pp. II–156 to 158). In addition, features incorporated in storage facilities are designed to mitigate the consequences of accidents caused by human error or otherwise (DOE PS IV–34).

The possibility of terrorist attacks on nuclear facilities was advanced as an argument against the acceptability of extended interim storage of spent fuel (NRDC PS p. 90). The intentional sabotage of a storage pool facility is possible, and NRC continues to implement actions to further improve security at such facilities. The consequences would be limited by the realities that, except for some gaseous fission products, the radioactive content of spent fuel is in the form of solid ceramic material encapsulated in high-integrity metal cladding and stored underwater in a reinforced concrete structure. Under these conditions, the radioactive content of spent fuel is relatively invulnerable to dispersal to the environment (Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel, NUREG–0575, Vol. 1.). Similarly, dry storage of spent fuel in dry wells, vaults, silos and metal casks is also relatively invulnerable to sabotage and natural disruptive forces, because of the weight and size of the sealed, protective enclosures which may include 100-ton steel casks, large concrete lined near-surface caissons and surface concrete silos (NUREG/CR–1223, p. IV–C–2).

E. Summary

In summary, the Commission finds that spent fuel can be stored safely at independent spent fuel storage installations or at reactor sites for at least 30 years beyond the expiration of reactor operating licenses. This finding is based on extensive experience and on many factors that are not site-specific. These factors include the substantial capability of the fuel cladding to maintain its integrity under storage conditions, a capability verified in extensive technical studies and experience; the extreme thermal and chemical stability of the fuel form, enriched uranium oxide pellets; the long-term capability of spent fuel storage facilities to dissipate spent fuel heat and retain any radioactive material leakage; and the relatively straightforward techniques and procedures for repairing spent fuel storage structures, replacing defective components or equipment, or undertaking other remedial actions to assure containment of radioactivity (A.B. Johnson, Jr., "Behavior of Spent Nuclear Fuel in Water Pool Storage", (UC–70) Battelle Pacific Northwest Laboratories (BNWL–2256, September 1977)). These factors contribute to the assurance that spent fuel can be stored for extended periods without significant impact on the public health and safety and the environment. Moreover, any storage of spent fuel at independent spent fuel storage installations or reactor sites beyond the operating license expiration will be subject to licensing and regulatory control to assure that operation of the storage facilities does not result in significant impacts to the public health and safety.

For the reasons discussed previously (Sections 2.4 A through D above), the Commission also concludes, from the record of this proceeding, that storage of spent fuel either at or away from a reactor site for 30 years beyond the operating license expiration would not result in a significant impact to the environment or an adverse effect on the public health and safety. The Commission's findings are also supported by NRC's experience in more than 80 individual safety evaluations of spent fuel storage facilities conducted in recent years. The record indicates that significant releases of radioactivity from spent fuel under licensed storage conditions are highly unlikely. This is primarily attributable to the resistance of the spent fuel to corrosive mechanisms and the absence of any conditions that would result in offsite dispersal of radioactive material. The Commission concludes that the possibility of a major accident or sabotage with off-site radiological impacts at a spent-fuel storage facility is extremely remote because of the characteristics of spent-fuel storage. These include the inherent properties of the spent fuel itself, the benign nature of the water pool or dry storage environment, and the absence of any conditions that would provide a driving force for dispersal of radioactive material. Moreover, there are no

significant additional non-radiological impacts which could adversely affect the environment if spent fuel is stored beyond the expiration of operating licenses for reactors. The non-radiological environmental impacts associated with site preparation and construction of storage facilities are, and will continue to be, considered by the NRC at the time applications are received to construct these facilities, which are licensed under NRC's regulations in either 10 CFR Part 50 for reactors or 10 CFR Part 72 for independent spent fuel storage facilities. The procedure to be followed in implementing the Commission's generic determination is the subject of rulemaking which the Commission has conducted.

2.5 Fifth Commission Finding

The Commission finds reasonable assurance that safe independent onsite spent fuel storage or offsite spent fuel storage will be made available if such storage capacity is needed.

The technology for independent spent fuel storage installations as discussed under the fourth Commission Finding, is available and demonstrated. The regulations and licensing procedures are in place. Such installations can be constructed and licensed within a five-year time interval. Before passage of the Nuclear Waste Policy Act of 1982 the Commission was concerned about who, if anyone, would take responsibility for providing such installations on a timely basis. While the industry was hoping for a government commitment, the Administration had discontinued efforts to provide those storage facilities (Tr. pp. 157–158). The Nuclear Waste Policy Act of 1982 establishes a national policy for providing storage facilities and thus helps to resolve this issue and assure that storage capacity will be available.

Prior to March 1981, the DOE was pursuing a program to provide temporary storage in off-site, or away-from-reactor (AFR), storage installations. The intent of the program was to provide flexibility in the national waste disposal program and an alternative for those utilities unable to expand their own storage capacities (DOE PS p. I–11; DOE CS p. II–66).

Consequently, the participants in this proceeding assumed that, prior to the availability of a repository, the Federal government would provide for storage of spent fuel in excess of that which could be stored at reactor sites. Thus, it is not surprising that the record of this proceeding prior to the DOE policy change did not indicate any direct commitment by the utilities to provide AFR storage. On March 27, 1981 DOE placed in the record a letter to the Commission stating its decision "to discontinue its efforts to provide Federal government-owned or controlled away-from-reactor storage facilities." The primary reasons for the change in policy were cited as new and lower projections of storage requirements and lack of Congressional authority to fully implement the original policy.

The record of this proceeding indicates a general commitment on the part of industry to do whatever is necessary to avoid shutting down reactors or derating them because of filled spent fuel storage pools. While industry's incentive for keeping a reactor in operation no longer applies after expiration of its operating license, utilities possessing spent fuel are required to be licensed and to maintain the fuel in safe storage until removed from the site. Industry's response to the change in DOE's policy on federally-sponsored away-from-reactor (AFR) storage was basically a commitment to do what is required of it, with a plea for a clear unequivocal Federal policy (Tr. pp. 157–159). The Nuclear Waste Policy Act of 1982 has now provided that policy.

The Nuclear Waste Policy Act defines public and private responsibilities for spent fuel storage and provides for a limited amount of federally-supported interim storage capacity. The Act also includes provisions for monitored retrievable storage facilities and for a research, development and demonstration program for dry storage. The Commission believes that these provisions provide added assurance that safe independent onsite or offsite spent fuel storage will be available if needed.

In Subtitle B of the Act, "Interim Storage Program," Congress found that owners and operators of civilian power reactors "have the primary responsibility for providing interim storage of spent nuclear fuel from such reactors" by maximizing the use of existing storage facilities onsite and by timely additions of new onsite storage capacity. The Federal government is responsible for encouraging and expediting the effective use of existing storage facilities and the addition of new storage capacity as needed. In the event that the operators cannot reasonably provide adequate storage capacity to assure the continued operation of such reactors, the Federal government will assume responsibility for providing interim storage capacity for up to 1900 metric tons of spent fuel (Sec. 131(a)). Such interim storage capacity is to be provided by the use of available capacity at one or more Federal facilities, the acquisition of any modular or mobile storage equipment including spent fuel storage racks, and/or the construction of new storage capacity at any reactor site (Sec. 135(a)(1)).

The Nuclear Waste Policy Act authorizes the Secretary of Energy to enter into contracts with generators or owners of spent fuel to provide for storage capacity in the amount provided in the Act (Sec. 136(a)(1)). However, such contracts may be authorized only if the NRC determines that the reactor owner or operator cannot reasonably provide adequate and timely storage capacity and is pursuing licensed alternatives to the use of Federal storage capacity (Sec. 135(b)).[8] Further, any spent fuel stored in the "interim storage program" is to be removed from the storage site on facility "as soon as practicable" but in no event later than 3 years following the availability of a repository or monitored retrievable storage facility (Sec. 135(e)). The Act establishes an "Interim Storage Fund" for use in activities related to the development of interim storage facilities, including the transportation of spent fuel and impact assistance to state and local governments (Sec. 136(d)).

In addition to providing for interim storage capacity, Congress found that "the long-term storage of high level radioactive waste or spent nuclear fuel in monitored retrievable storage facilities is an option for providing safe and reliable management of such waste or spent fuel." By June 1, 1985, the Secretary of Energy must complete a detailed study of the need for, and feasibility of, such a facility and submit to Congress a proposal for the construction of one or more such facilities. The Act also directs the Secretary of Energy to establish a demonstration program, in cooperation with the private sector, for the dry storage of spent nuclear fuel at reactor sites and provide consultative and technical assistance on a cost-sharing basis to assist utilities lacking interim storage capacity to obtain the construction, authorization and appropriate license from the NRC. Such assistance may include the establishment of a research and development program for the dry storage of no more than 300 metric tons of spent fuel at federally-owned facilities (Sec. 218, (a)(b)(c)).

The Commission's confidence that independent on-site and/or off-site

[8] Accordingly, the Commission has published proposed "Criteria and Procedures for Determining the Adequacy of Available Spent Nuclear Fuel Storage Capacity," 10 CFR Part 53 (48 *FR* 19382, April 29, 1983).

storage capacity for spent fuel will be available as needed is further supported by the strong likelihood that only a portion of the total spent fuel generated will require storage outside of reactor storage basins (DOE PS pp. V–3 to V–13). Estimates of the amount of spent fuel requiring storage away from reactors have declined significantly over the duration of this proceeding (DOE March 27, 1981 letter from O. Brown II, DOE Office of General Counsel, to M. Miller NRC, Presiding Officer in this proceeding).

DOE reported that cummulative spent fuel discharges, previously estimated as 100,000 metric tons of uranium (MTU), dropped to 72,000 MTU through the year 2000. Projected requirements for additional spent fuel storage capacity begin in 1986 (instead of 1981) and increase to 9500 MTU per year by 1997 Earlier projections indicated a need for 16,000 MTU per year for additional storage capacity in 1997 [9] DOE pointed out that additional storage requirements could be satisfied in a number of ways, including: (a) Use of private existing AFR storage facilities; (b) construction of new water basins at reactor facilities or away from reactor facilities by private industry or the utilities; (c) transshipment of spent fuel between reactors operated by different utilities; (d) disassembly of spent fuel and storage of spent fuel rods in canisters; and (e) dry storage at reactor sites.

Subsequently, DOE published new estimates for additional spent fuel storage capacity ("Spent Fuel Storage Requirements", DOE/RL–82–1, June, 1982). These estimates show a maximum required away-from-reactor (AFR) storage capacity of 8610 metric tons uranium of spent fuel in the year 1997 This is a decline from DOE's previously published planning-base case. The information in Table 1 below is excerpted from DOE/RL–83–1 and provides a range of projections of additional storage capacity needs. The first column is a projection of storage capacity needed over and above the currently existing and planned storage capacity. The second column provides projected values of additional storage capacity needed if maximum re-racking is conducted at existing or planned reactor basin storage pools. The storage capacity needs shown in the second column are somewhat smaller than in the first column. A further decrease in additional needed storage capacity is shown in the third column, which takes into account the possibility of transshipment of fuel from one reactor basin to another basin owned by the same utility. The projected values of needed storage capacity in the first and third columns provide a range of upper and lower bound values, respectively. The most likely outcome expected by DOE corresponds to the values in the second column. This was formerly known as the planning base case and is now termed the reference case. All projections shown in the table assume the maintenance of a full core reserve. The magnitude of need for additional spent fuel storage capacity projected by DOE has continued to decline, even though DOE has not assumed the use of newly developed technology, such as fuel rod consolidation.

The cumulative amount of spent fuel to be disposed of in the year 2000 is expected to be 58,000 metric tons of uranium [Spent Fuel Storage Requirements (Update of DOE/RL–82–1) DOE/RL–83–1, published January, 1983]. The additional required storage capacity of 13,000 metric tons of uranium projected in the second column for the year 2000 is less than 25% of the total quantity of spent fuel projected to be in storage. It is expected that additional storage will be provided at the reactor site, with some smaller portion to be moved offsite.

TABLE 1.—ADDITIONAL CUMULATIVE SPENT FUEL STORAGE REQUIREMENTS, OVER AND ABOVE CURRENT AND PLANNED STORAGE AT REACTOR STORAGE BASINS (METRIC TONS OF URANIUM)[1]

	No change in current or planned storage capacity	Use maximum reracking of current and planned storage capacity	Maximum reracking plus transshipment
Year:			
1982	0	0	0
1983	0	0	0
1984	13	13	0
1985	13	13	0
1986	110	110	3
1989	550	420	60
1990	1,560	1,300	310
1995	5,610	5,060	3,000
2000	14,760	13,000	10,370

[1] Spent Fuel Storage Requirements (Update of DOE/RL–82–1) DOE/RL–83–1, published January, 1983.

In response to the Commission's Second Prehearing Memorandum and Order (Nov. 6, 1981) the participants commented on the significance to the proceeding of issues resulting from the DOE policy change on spent fuel storage. The utilities generally limited their written responses to a restatement of the safety of interim storage and an affirmation of the technical and practical feasibility of the alternatives to Federal AFR storage facilities. An implied commitment by industry to implement AFR storage if necessary using one of the several feasible spent fuel storage alternatives is evident from the responses of the utilities, the nuclear industry, and associated groups (i.e., Tr. p. 159).

Based upon the foregoing, the Commission has, then, reasonable assurance that safe independent onsite or offsite spent fuel storage will be available if needed. The technology is demonstrated and the licensing procedures in place. The Nuclear Waste Policy Act establishes a national policy on interim storage of spent fuel and provides for contingency Federal storage capacity to augment that provided by industry. Further, the amount of fuel which may have to be stored in independent spent fuel storage facilities is less than was originally thought.

Reference Notation

The following abbreviations have been used for the reference citations in the Appendix:

PS Position Statement
CS Cross-Statement
PHS Pre-Hearing Statement
Tr. Transaction* of January 11, 1982 public meeting with the Commissioners

Participants have been identified by the following citations:

Citation and Participant

AIChE—American Institute of Chemical Engineers
ANS—American Nuclear Society
AEG—Association of Engineering Geologists
AIF—Atomic Industrial Forum, Inc.
—Bech—Bechtel National, Inc.
CDC—California Department of Conservation
CEC—California Energy Commission
CPC—Consumers Power Company
Del—State of Delaware
DOE—U.S. Department of Energy
ECNP—Environmental Coalition on Nuclear Power
GE—General Electric Company
Ill—State of Illinois (PS includes Roy affidavit)
Lewis—Marvin I. Lewis
Lochstet—Dr. William A. Lochstet
Minn—State of Minnesota
MAD—Mississippians Against Disposal
NECNP—New England Coalition on Nuclear Pollution
NIE—Neighbors for the Environment (PS includes papers by Dornsife, Rae, and Strahl)
NRDC—Natural Resources Defense Council, Inc.
NY—State of New York

[9] DOE's planning-base studies assume maximum basin re-racking at reactors and the maintenance of full-core reserve in reactor basins.

*The Commission considers this transcript to be part of the administrative record in this rulemaking. However, the transcript has not been reviewed for accuracy by the Commission on the participants, and therefore is only an informal record of the matters discussed.

OCTLA—Ocean County and Township of Lower Alloway Creek
Ohio—State of Ohio
SC—State of South Carolina
SE2—Scientists and Engineers for Secure Energy, Connecticut Chapter
SHL—Safe Haven, Ltd.
SMP—Sensible Main Power, Inc.
TVA—Tennessee Valley Authority
UNWMG-EEI—Utility Nuclear Waste Managment Group—Edison Electric Institute
USGS—United States Geological Survey
Vt—State of Vermont
Wis—State of Wisconsin (PS includes comments by Deese, Mudrey, Kelly, and Leverance)
UG—The Utilities Group (Niagara Mohawk Power Corp., Omaha Public Power District, Power Authority of the State of New York, and Public Service Company of Indiana, Inc.)

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10 CFR Parts 50 and 51

Requirements for Licensee Actions Regarding the Disposition of Spent Fuel Upon Expiration of Reactor Operating Licenses

AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Nuclear Regulatory Commission is amending its regulations to incorporate the following provisions: (1) The Commission has reasonable assurance that no significant environmental impacts will result from the storage of spent fuel for at least 30 years beyond the expiration of nuclear reactor operating licenses. Accordingly, no discussion of any environmental impact of spent fuel storage for the period following expiration of the license or amendment applied for, is required in connection with the issuance or amendment of an operating license for a nuclear reactor or in connection with the issuance of an initial license or an amendment to an initial license for an independent spent fuel storage installation. (2) Operating nuclear power reactor licensees are required no later than 5 years before expiration of the reactor operating license, to submit for NRC review and approval, their plans for managing spent fuel at their site until the spent fuel is transferred to the Department of Energy for disposal.

EFFECTIVE DATE: November 29, 1984.

FOR FURTHER INFORMATION CONTACT: Dennis Rathbun or Clyde Jupiter, Office of Policy Evaluation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone (202) 634-3295, or Sheldon Trubatch, Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, telephone (202) 634-3224.

SUPPLEMENTARY INFORMATION:

Background

By a Notice of Proposed Rulemaking dated October 25, 1979 (44 FR 61372), the Nuclear Regulatory Commission ("Commission" or "NRC") began a generic rulemaking proceeding "to reassess its degree of confidence that radioactive wastes produced by nuclear facilities will be safely disposed of, to determine when any such disposal will be available, and whether such wastes can be safely stored until they are safely disposed of." This proceeding became known as the "Waste Confidence" rulemaking proceeding, and was conducted partially in response to a remand by the United States Court of Appeals for the D.C. Circuit. *State of Minnesota* v. *NRC*, 602 F.2d 412 (1979). *State of Minnesota* involved a challenge to license amendments to permit the expansion of spent fuel pool storage capacities at two nuclear power plants. It was contended that uncertainty regarding ultimate disposal of commercial nuclear wastes required the Commission to consider the safety and environmental implications of storing spent fuel in the pools for an indefinite period following expiration of the plants' operating licenses. The Commission had excluded consideration of such long-term onsite storage from the license amendment proceedings, relying on its earlier finding (42 FR 34391, July 5, 1977) that safe permanent disposal of reactor wastes would be available when needed.

The Court of Appeals agreed with the Commission that, in accordance with the "rule of reason" implicit in the National Environmental Policy Act (NEPA), impacts of extended on-site storage of spent fuel need not be considered in licensing proceedings unless such storage was reasonably foreseeable and not merely a theoretical possibility. The Court held, however, that the Commission's statement of reasonable confidence in the timely availability of waste disposal solutions was "not the product of a rulemaking record devoted expressly to considering the question" and furthermore did not address the particular problem whether disposal solutions would be available before the expiration of plant operating licenses. *Id.* at 417 Accordingly, the D.C. Circuit remanded to the Commission for determination "whether there is reasonable assurance that an off-site storage solution will be available by the years 2007-2009, the expiration of the plants' operating licenses, and if not, whether there is reasonable assurance that the fuel can be stored safely at the site beyond those dates." *Id.* at 418. The Court noted that "the breadth of the questions involved and the fact that the ultimate determination can never rise above a prediction suggest that the determination may be a kind of legislative judgment for which rulemaking would suffice." *Id.* at 417 The Court agreed that the Commission "may proceed in these matters by generic determinations." *Id.* at 419. *Accord, Potomac Alliance* v. *NRC*, 682 F.2d 1030 (D.C. Cir. 1982).

Amendment to Part 51

Elsewhere in this issue, the Commission announced the conclusions it reached in the Waste Confidence rulemaking proceeding. The Commission found that there is reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by 2007-2009. However, some reactor operating licenses may expire without being renewed or some reactors may be permanently shut down prior to this period. Since independent spent fuel storage installations have not yet been extensive by developed, there is then a probability that some onsite spent fuel storage after license expiration may be necessary or appropriate. In addition, the Commission also realizes that some spent fuel may be stored in existing or new storage installations for some period beyond 2007-2009.

The Commission hereby adopts a rule providing that the environmental impacts of at-reactor storage after the termination of reactor operating licenses need not be considered in Commission proceedings related to issuance or amendment of a reactor operating license. This rule has the effect of continuing the Commission's practice, employed in the proceedings reviewed in *State of Minnesota*, of limiting considerations of environmental impacts of spent fuel storage in licensing proceedings to the period of the license in question and not requiring the NRC staff or the applicant to address the impacts of extended storage past expiration of the license applied for. The rule relies on the Commission's generic determination in the Waste Confidence proceeding that the licensed storage of spent fuel for 30 years beyond the reactor operating license expiration either at or away from the reactor site is feasible, safe, and would not result in a significant impact on the environment. For the reasons discussed in the Waste Confidence decision, the Commission believes there is reasonable assurance

that adequate disposal facilities will become available during this 30-year period. Thus, there is no reasonable probability that storage will be unavoidable past the 30-year period in which the Commission has determined that storage impacts will be insignificant.

The same safety and environmental considerations apply to fuel storage installations licensed under Part 72 as for storage in reactor basins. Accordingly, in licensing actions involving (a) the storage of spent fuel in new or existing facilities, or (b) the expansion of storage capacity at existing facilities, the NRC will continue to require consideration of reasonably foreseeable safety and environmental impacts of spent fuel storage only for the period of the license applied for. The amendment to 10 CFR Part 51 confirms that the environmental impacts of spent fuel storage in reactor facility storage pools or independent spent fuel storage installations for the period following expiration of the reactor or installation storage license or amendment applied for need not be addressed in any environmental report, impact statement, impact assessment, or other analysis prepared in connection with the reactor operating license or amendment to the operating license, or initial license for an independent spent fuel storage installation, or amendment thereto.

The Commission's conclusions with respect to safety and environmental impacts of extended storage beyond expiration of current operating licenses are supported by the record in NRC's Waste Confidence proceeding and by NRC's experience in more than 80 individual safety and environmental evaluations conducted in storage licensing proceedings. The record of the Waste Confidence proceeding indicates that significant release of radioactivity from spent fuel under licensed storage conditions is highly unlikely because of the resistance of the spent fuel cladding to corrosive mechanisms and the absence of any conditions that would provide a driving force for dispersal of radioactive material. The non-radiological environmental impacts associated with site preparation and construction of storage facilities are and will continue to be considered by the NRC at the time applications are received to construct these facilities, which are licensed under NRC's regulations in either 10 CFR Part 50 for reactors or 10 Part 72 for independent spent fuel storage installations. There are so significant additional non-radiological impacts which could adversely affect the environment for storage past the expiration of operating licenses at reactors and independent spent fuel storage installations.

The amendments to Part 51 published here include § 51.23 (a), (b) and (c) as well as conforming amendments in §§ 51.30(b), 51.53 (a) and (b), 51.61, 51.80, 51.95 and 51.97. Paragraph 51.23(a) is a restatement of a final generic Commission determination (elsewhere in this issue) based on the Waste Confidence rulemaking proceeding, while § 51.23 (b) and (c) establish the procedures for implementing that generic determination in individual licensing cases.

Amendment to Part 50

The Commission is also adopting an amendment to 10 CFR Part 50 as set forth here, concerning the management of spent fuel from nuclear power reactors whose operating licenses may expire prior to the availability of a repository. The procedures established by this amendment are intended to confirm that there will be adequate lead time for whatever actions may be needed at individual reactor sites to assure that the management of spent fuel following the expiration of the reactor operating license will be accomplished in a safe and environmentally acceptable manner.

The Commission amends § 50.54 to establish requirements that the licensee for an operating nuclear power plant reactor shall no later than 5 years prior to expiration of the reactor operating license submit plans for NRC review and approval of the actions which the licensee proposes for management of all irradiated fuel at the reactor upon expiration of its operating license. No specific course of action is required of the licensee by the NRC. Licensee actions could include, but are not necessarily limited to, continued storage of spent fuel in the reactor spent fuel storage basin, storage in an independent spent fuel storage installation (refer to 10 CFR 72.3(m)) located at the reactor site or at another site; transshipment to and storage of the fuel at another operating reactor site in that reactor's basin; reprocessing of the fuel if it appears that licensed reprocessing facilities will be available; or disposal of the fuel in a repository. The proposed licensee actions must be consistent with NRC requirements for licensed possession of irradiated or spent fuel (as defined in § 72.3(v)) and must be capable of being authorized by the NRC and implemented by the licensee on a timely basis. The licensee's plans must specify how the financial costs of extended storage or other disposition of spent fuel will be funded. Further, the licensee's plans must describe the proposed disposition of all irradiated fuel from the reactor. The licensee shall notify the NRC of any significant changes to these plans; changes are not precluded provided that the licensee maintains the capability to manage the spent fuel safely.

The Commission notes that extended storage of spent fuel at a reactor beyond the expiration date of the operating license will require an amendment to the Part 50 license to cover possession only of the reactor and spent fuel under the requisite provisions of Parts 30, 50 and 70, or an authorization pursuant to Part 72, "Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation" [ISFSI]. This rulemaking does not alter the requirements and provisions of Parts 51 and 72 with respect to the performance of environmental reviews of the impacts of spent fuel storage in an independent spent fuel storage installation or extended storage in a reactor spent fuel pool. This means that the NRC staff will continue to perform environmental reviews before issuing a license under 10 CFR Part 72 or an amendment for extended storage under 10 CFR Part 50. Notice of the receipt of a license application for storage of spent fuel pursuant to Part 72 will be published in the Federal Register.

Related Commission Actions

On March 13, 1978, the NRC published an Advance Notice of Proposed Rulemaking indicating that the NRC was reevaluating its decommissioning policy and considering amending its regualtions to provide more specific guidance on decommissioning of nuclear facilities (43 FR 10370). In January 1981, NRC published a "Draft Generic Environmental Impact Statement on Decommissioning Nuclear Facilities" (NUREG-0586). Proposed amendments to 10 CFR Parts 30, 40, 50, 51, 70, and 72 are being prepared by the NRC staff for Commission consideration. The proposed amendments for decommissioning would allow unrestricted use of a reactor or independent spent fuel storage installation site and would permit termination of the license. However, the storage of irradiated fuel either in a reactor basin or in an independent spent fuel storage installation would require restricted access and management of the storage facility to protect public health and safety. Thus, any continued storage of spent fuel beyond expiration of an operating license would be licensed under either Parts 50 or 72 and could

preclude final decommissioning of the site.

Analysis of Public Comment

1. Introduction

Proposed amendments to 10 CFR Parts 50 and 51, related to the Commission's Waste Confidence decision, were published in the Federal Register (48 FR 22730) for public comment on May 20, 1983. Section 50.54(aa) (formerly identified as § 50.54(x)) proposed to require licensees to submit no later than 5 years before expiration of reactor operating licenses a plan for post-operation management of spent fuel which is onsite at the time of license expiration. Section 51.23(a) (formerly identified as § 51.5(e)(1)) proposed a restatement of the Commission's generic determination in the Waste Confidence decision that no significant environmental impacts will result from onsite or offsite storage of spent fuel up to 30 years after reactor operating license expiration, that there is reasonable assurance that a repository will be available by 2007–2009, and that sufficient repository capacity will be available within 30 years beyond license expiration to dispose of reactor waste and spent fuel. Section 51.23(b) (formerly identified as § 51.5(e)(2)) proposed that the environmental impacts of potential extended spent fuel storage (i.e., storage beyond the period of an existing or initial license) need not be addressed in connection with a reactor operating license or the license for an independent spent fuel storage installation.

Comments were received from 21 respondents to the May 20, 1983 request. In addition to substantive comments discussed below, some commenters questioned: (1) The adequacy of the opportunity to comment on the Commission's fourth finding and supporting documentation; (2) the Commission's compliance with NEPA. In response, the Commission reopened the comment period (48 FR 50746, November 3, 1983). These later comments represent expanded discussions of procedural and environmental issues raised in the May 20, 1983 comment period and the Commission's responses to them are set out in the companion Waste Confidence decision published concurrently with this document. For the reasons discussed there, the Commission found no basis to modify its fourth finding or the related supporting documentation. The participants are identified by the abbreviated citations defined in Section 5 below.

2. Proposed Provisions of 10 CFR 50.54(bb)

a. Timely Submission of Spent Fuel Management Plans

(1) *Summary of Comments.* The proposed rule would require each reactor licensee to submit, no later than 5 years before expiration of the operating license, written notification to the Commission describing the licensee's program for post-operational management of all irradiated fuel which is at the reactor at the time of. exporation of the operating license, pending ultimate disposal of the irradiated fuel in a repository.

Some respondents agreed with the proposed notification date (Tol. Ed., UNWMG–EEI p. 3; MP&L). Others believed that the submittal of notification only 5 years before expiration of the reactor operating license was too late; rather, they would require utilities with operating reactors to submit spent fuel management plans within six months of issuance of this rule. For new reactors, these latter respondents advocated submission of plans prior to issuance of an operating license (UCS p. 2; NECNP p. 1; Hiatt) or even sooner (CNPP p. 1). Still others agreed that early planning was essential but did not recommend specific timing for submittal of plans (Wis. p. 2; ISAS p. 1; WED, EPI pp. 1, 2).

Among the reasons advanced for recommending an earlier planning requirement were the following: Industry's alleged record of reluctance to accept its responsibilities for spent fuel storage (Hiatt; ISAS p. 1; EPI p. 1); five years before license expiration the utility's primary concerns would be the massive inventory of spent fuel on hand, possible financial constraints as a result of reduction in the rate base, and the need to concentrate on newer and more long-term generating facilities (UCS, p. 2). UCS remarked that the requirement to submit a management plan near the end of the license term implied NRC might be willing to permit development of onsite semi-permanent storage facilities (UCS p. 2). Other respondents pointed out that earlier planning for spent fuel management is needed because the reactor may be shut down prior to the license expiration date; some plants may be shut down prematurely as a result of accidents or inability to meet newer regulatory requirements, and others may be shut down because of premature aging, steam generator or primary system degradation, or unacceptable severe accident risks (ISAS p. 1; EPI pp. 1, 2). One respondent recommended that the NRC require utilities to prepare spent fuel management plans every 5 years (EPI p. 3).

The Utility Decommissioning Group stated that consideration of premature shutdown due to accidents or other conditions was speculative and irrelevant to the Commission's proposed rule (UDG p. 7). An industry representative commented that the requirement to verify submittals for NRC authorizations was inappropriate since some authorizations would not be needed as early as five years before operating license expiration; an alternative schedule for seeking such authorizations was suggested (AIF, p. 7). Finally, one respondent stated that licensee plans should only address spent fuel management up to the time when the material and title are delivered to DOE for disposal (SE2 p. 4).

(2) *NRC Response.* The Commission believes that the choice of five years prior to operating license expiration represents a reasonable timeframe for licensees to submit their spent fuel management plans.

Delaying a request for such plans until the license expiration is imminent would not permit the timely implementation of alternative actions in the event deficiencies in the plans are identified by the Commission. Time is needed to ensure that the proposed plans are consistent with the licensee's long range plans, such as decommissioning, and that the plans meet whatever requirements are involved in the transfer of title to spent fuel to the Secretary of Energy for disposal in a repository.

On the other hand, the Commission believes that a requirement for a licensee to develop spent fuel management plans a decade or two before license expiration would be unnecessarily restrictive and could even be counterproductive. Such premature plans would be likely to undergo several revisions to accommodate to changing circumstances and their usefulness would be questionable.

Premature shutdown or termination of a reactor's license which results in an unanticipated need for interim storage or disposal arrangements is not expected to be a generic problem. The Commission will consider the consequences of premature termination of operation, should such an event occur, on a case-by-case basis. Even if a reactor shuts down prematurely, it will still be required to comply with license requirements.

Premature shutdown of a reactor could not pose a problem for storage of spent fuel, because intermediate or long-term demands on the spent fuel storage

facilities at a shutdown reactor (whether shut down prematurely or because of operating license expiration) will be limited by termination of spent fuel production. Any short-term need for storage would be related to the desirability of maintaining a full core reserve, which is not a safety issue.

AIF's concern that it may be inappropriate for a licensee to apply for all necessary NRC authorizations five years before license expiration has been taken into account by changing the third sentence of the proposed § 50.54(bb) to read "Where implementation of such actions require NRC authorizations, the licensee shall verify in the notification that submittals for such actions have been *or will be* made to NRC and shall identify them." (Emphasis added.)

Under the terms of the Nuclear Waste Policy Act of 1982, the Secretary of Energy will take title to spent fuel at a licensee's facility and transport the spent fuel to a repository for ultimate disposal. Because of this, each licensee's spent fuel management plans need only consider actions to be taken until the time of spent fuel transfer to the Secretary of Energy, rather than until the time of ultimate disposal. The final words of the first sentence of the proposed § 50.54(bb) have been revised to read " until *title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its* ultimate disposal in a repository." (Emphasis added.)

b. Plans for Funding Spent Fuel Management

(1) *Summary of Comments.* The proposed rule would require a licensee's notification to include plans for financing the management of all irradiated fuel upon expiration of the reactor operating license until the ultimate disposal of the fuel in a repository.

Some respondents believed that the funding for spent fuel management should be considered together with funding for decommissioning (e.g., UDG pp. 5–7; UNWMG–EEI, p. 5; Tol Ed; AIF p. 6). They contended that, if funding for spent fuel management were to be addressed separately from decommissioning, the Commission should recognize that utilities generally would be permitted by the rate-making authorities to recover costs associated with extended fuel storage (UDG p. 6; AIF pp. 7, 8). Moreover, since each utility will have to demonstrate to NRC its ability to finance decommissioning—which will involve far greater costs than the maintenance and monitoring of spent fuel storage—the funding required for post-operating license spent fuel management will be assured (UDG pp. 5–7; AIF pp. 7, 8). Others believe that the funding required for post-OL management of spent fuel would be assured because the utilities are financially responsible (UDG pp. 5–7; AIF pp. 7, 8); still others contended that if a utility operates a reactor, it should be required to have adequate funding set aside now to manage the spent fuel (UCS p. 3). On the other hand, some respondents expressed the view that, when the notification of plans is due, a utility might not wish to spend or even retain the funds required for spent fuel management (CNPP p. 1), e.g., Turkey Point, (FUSE p. 2).

(2) *NRC Response.* Following termination of reactor operation, actions to manage irradiated fuel stored on the plant site or to provide for its removal would include activities taken prior to and subsequent to decommissioning. In all cases after operating license termination, continued spent fuel storage at the nuclear power plant site would be subject to licensing under 10 CFR Part 50 or 72.

The suggestion that funding for decommissioning and spent fuel management be considered together would appear to offer no significant advantage. The costs of each are readily separable. Moreover, it is possible that rate-making authorities will treat cost recovery for decommissioning differently from costs of extended spent fuel storage, in which case separation of costs would be necessary. In addition, the scheduling of spent fuel storage and disposal is likely to depend primarily on factors not directly related to decommissioning such as irradiated fuel age, status of disposal facilities and availability of spent fuel transport casks. The Commission also notes that all reactor licensees have contracted with DOE for disposal of their spent fuel; further, any new reactor operating license will require that the licensee have a contract in place with DOE for disposal of all spent fuel generated.

c. Meaning of "Approval" of Plans for Spent Fuel Management

(1) *Summary of Comments.* The proposed 10 CFR 50.54(bb) provides for Commission "review and approval" of the licensee's spent fuel management plans. One respondent noted that there is no indication whether the NRC "approval" would take the form of an order or a license amendment and recommended that the concept of "approval" be eliminated from the rule (AIF pp. 6, 7). Others characterized formal approval as unnecessary (UDG p. 7) and burdensome (UNWMG–EEI, pp. 3–5; Tol. Ed.), or as creating "a new layer of approvals" (SE2 p. 3). It was suggested that the NRC staff review the plans, alert licensees to any deficiencies, and undertake formal approval only when action is taken to implement the plan through license amendments or other regulatory actions (AIF pp. 6,7; UNWMG–EEI p. 4).

(2) *NRC Response.* The Commission's review of each licensee's plans for management and ultimate disposal of all irradiated fuel at the reactor following operating license expiration is intended to assure that each licensee has made adequate advance preparations, including allowance for contingencies, for managing spent fuel in a manner which provides adequate protection of the public health and safety and the environment until it is transferred to the Secretary of Energy for disposal. Because the plans would be developed at least five years prior to operating license expiration, they would be based on the utility's forecast of its future situation. Some utilities may have sufficient uncertainty in their forecasts to preclude an early firm commitment to details of a program for management of spent fuel after operating license expiration. Accordingly, the Commission will consider the notification to be submitted under § 50.54(bb) as a formal expression of intent. The notification is part of an information gathering process which is more specific, but similar in nature to the provisions of § 50.54(f), which states:

> The licensee will at any time before expiration of the license, upon request of the Commission submit written statements, signed under oath or affirmation, to enable the Commission to determine whether or not the license should be modified, suspended or revoked.

The provisions of § 50.54(bb) may be used by the Commission in determining if it needs to take any further action. The Commission's review will focus on the identification of discrepancies or omissions and its "approval" will signify that, based on the information available at the time of filing the notification, the licensee's plans are sound and will provide adequate protection of the public health and safety and the environment. Between the time the Commission indicates its preliminary approval of the plans and the date of expiration of the operating license, the licensee may propose for Commission consideration modifications or supplementation of its plans. In this way, prior to license expiration, the licensee will have developed a course of action which the Commission has approved as satisfying the regulatory requirements for safety and

environmental protection. The plan would then, at license expiration and termination of reactor operation, become part of the conditions of an amended Part 50 license for a shut down reactor facility, or a Part 72 license for storage of spent nuclear fuel following termination of reactor operation.

In order to clarify the Commission's intent that the Commission's approval of the licensee's plans for spent fuel management is not a final approval, the word "preliminary" has been inserted before "approval" in the first sentence of the proposed § 50.54(bb) and the following sentence is inserted after the first sentence: "Final Commission review will be undertaken as part of the proceeding for continued licensing under Part 50 or Part 72."

d. Relationship of Extended Spent Fuel Storage to Decommissioning

(1) *Summary of Comments.* In view of the potential juxtaposition of actions to implement spent fuel management plans addressed in § 50.54(bb) and decommissioning plans, some respondents urged that promulgation of the former be considered in the decommissioning rulemaking (UDG pp. 3–6) or coordinated with the decommissioning requirements (UDG pp. 5–7; UNWMG–EEI p. 5; EPI p. 2; AIF pp. 5, 6; Pilalis p. 2; MSS p. 2). The concerns were that the two rules (§ 50.54(bb) and decommissioning) might be conflicting or duplicative with respect to site access, preferred decommissioning mode, and financing (Pilalis p. 1; AIF pp. 5, 6). The record of the decommissioning rulemaking was cited as providing support for the Commission's determination that the environmental and safety implications of extended storage of spent fuel need not be considered in licensing proceedings (AIF pp. 3, 4; UDG p. 5).

(2) *NRC Response.* Here again, the Commission considers the decommissioning process as a set of actions separate from those discussed in § 50.54(bb). To delay issuance of a rule for extended spent fuel storage in order to combine it with the decommissioning rule which is being developed would serve no useful purpose. The safety and environmental implications of the two processes differ significantly. Specifically, decommissioning involves many more complex considerations than post-OL spent fuel management plans. Although the two activities may overlap in time, they are so different that combining the associated regulatory requirements into a single rulemaking would have no apparent advantage.

Although there is a potential for overlap between the plans submitted in the § 50.54(bb) notification and the decommissioning plans, the overlap is most likely to be limited to scheduling aspects, e.g., situations where the presence of spent fuel in the reactor storage pool must be taken into account when considering decommissioning options. The Commission does not consider the potential for conflict from such overlapping activities to be sufficient to delay the present rulemaking until decommissioning regulations are in place. Clearly the utility must decide which decommissioning option it wishes to choose before operating license expiration. The utility's spent fuel management plans submitted in response to § 50.54(bb) and its choice of decommissioning options, should be consistent. Such consistency may be achieved by modifying either the decommissioning plan, the spent fuel management plan, or both.

3. Miscellaneous Comments

a. Recognition of Yakima Indian Rights

(1) *Summary of Comments.* The Yakimas stated that their sovereign rights cannot be properly protected by generalized rulemaking and that Federal rules must be based upon recognition of their treaty rights (YIN p. 2). They also contended that environmental impact analyses for siting nuclear waste storage and disposal facilities are based on value systems not related to those of affected Indian tribes (YIN, Enclosure 2). The Yakimas believe that environmental impact studies have consistently failed to look beyond the Judaeo-Christian socio-economic heritage and as a result there have been repeated nuisance violations of the sovereign rights guaranteed to the Yakimas by the Treaty of 1855 (YIN p. 2 of Attachment 2).

(2) *NRC Response.* This final rule does not concern repository siting, or the extended storage of spent fuel at any reactor located within the tribal lands. Siting will be considered under procedures laid out by the Nuclear Waste Policy Act (NWPA), DOE siting guidelines, and NRC regulations for high-level waste disposal (10 CFR Part 60). All of these recognize Indian rights in the siting of waste repositories and provide for participation by affected Indian tribes.

b. Extended Length of Time for Storage

(1) *Summary of Comments.* The Environmental Policy Institute states that the Commission may not assume that plants will be able to dispose of fuel in a repository on a schedule reflecting OL termination because the NWPA carries a presumption that significant repository capacity will be taken up by defense waste; moreover, section 135(e) of the NWPA requires that spent fuel in interim Federal storage must be moved within three years of the availability of permanent disposal of storage facilities. Furthermore, EPI notes that DOE proposes in its contracts to give priority to the oldest fuel (EPI pp. 2, 3). Pilalis adds that the contracts give priority to fuel from permanently shutdown reactors.

(2) *NRC Response.* The Commission notes that the various categories (e.g., wastes from commercial or defense activities) of high-level waste and spent fuel are addressed in the NWPA in a manner which assures that they will be dealt with or managed and disposed of with appropriate priorities. The NWPA mandates a Mission Plan from the Secretary of DOE (section 301(a)), which includes:

> an estimate of (A) the total repository capacity required to safely accommodate the disposal of all high-level radioactive waste and spent nuclear fuel expected to be generated through December 31, 2020, in the event that no commercial reprocessing of spent nuclear fuel occurs, as well as the repository capacity that will be required if such reprocessing does occur, (B) the number and type of repositories required to be constructed to provide such disposal capacity; (C) a schedule for the construction of such repositories; and (D) an estimate of the period during which each repository listed in such schedule will be accepting high-level radioactive waste or spent nuclear fuel for disposal; (section 301(a)(9)).

Thus the intention of the NWPA is to provide adequate repository capacity on a timely basis for all high-level radioactive waste and spent fuel and to take into account the various priorities for disposal established by the Act itself. The Commission notes in its Waste Confidence decision (elsewhere in this issue) that:

> sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of commercial high-level radioactive waste and spent fuel generated up to that time. The Nuclear Waste Policy Act of 1982 establishes Federal responsibility and a clearly defined Federal policy for the disposal of such waste and spent fuel and creates a Nuclear Waste Fund to implement Federal policy. The Act establishes as a matter of national policy that this responsibility is a continuing one, and provides means for the Secretary of Energy to examine periodically the adequacy of resources to accomplish this end (Appendix to the Commission's decision [section 2.2B4]).

In any event, the Commission does not assume, as EPI contends, that plants will be able to dispose of spent fuel in a

repository on a schedule corresponding to OL termination. The Commission's second finding states (in part) that sufficient repository capacity will be available within 30 years beyond OL termination. The priority that DOE proposes to follow in its contracts for acceptance of the oldest spent fuel does not affect this situation.

4. Non-Substantive Revisions in the Amendment to 10 CFR Part 51.

Non-substantive revisions were made in the amendment to Part 51 for clarification and to conform to the recently published (49 FR 9352, March 12, 1984, effective June 7, 1984, 49 FR 24512, June 14, 1984) general revision of 10 CFR Part 51 and related conforming amendments implementing CEQ NEPA regulations.

5. Listing of Participants

Respondents to the May 29, 1983 Invitation for Public Comment (48 FR 22730) on the Proposed Amendments to 10 CFR Parts 50 and 51, "Requirements for Licensee Actions Regarding the Disposition of Spent Fuel Upon Expiration of the Reactor's Operating License

1. New York Attorney General (NY Atty. Gen.)
2. Floridians United for Safe Energy (FUSE)
3. Toledo Edison Company (Tol. Ed.)
4. Environmental Policy Institute (EPI)
5. Utility Decommissioning Group (UDG)
6. Atomic Industrial Forum, Inc. (AIF)
7. Utility Nuclear Waste Management Group and the Edison Electric Institute (UNWMG—EEI)
8. Wisconsin (Wis.)
9. Middle South Services, Inc. (MSS)
10. Coalition for Nuclear Power Postponement (CNPP)
11. Union of Concerned Scientists (UCS)
12. Indiana Sassafras Audubon Society (ISAS)
13. Yakima Indian Nation (YIN)
14. Wisconsin Environmental Decade (WED)
15. Labros E. Pilalis (Pilalis)
16. New England Coalition on Nuclear Pollution, Inc. (NECNP)
17. Scientists and Engineers for Secure Energy, Inc. (SE2)
18. Susan L. Hiatt (Hiatt)
19. Mississippi Power and Light Co. (MP&L)
20. Department of Energy (DOE)
21. Consolidated Public Interest Representative (CPIR)

Respondents to the Commission's November 3, 1983 Order (48 FR 50746) To Reopen the Period for Limited Comment on the Environmental Aspects of the Commission's Fourth Finding in the Waste Confidence Proceeding

1. Attorney General of the State of New York (N.Y.)
2. Marvin Lewis (Lewis)
3. Sierra Club Radioactive Waste Campaign (Sierra)
4. Scientists and Engineers for Secure Energy, Inc. (SE2)
5. Safe Haven, Ltd. (S.H.)
6. American Institute of Chemical Engineers (AIChE)
7. Atomic Industrial Forum, Inc. (AIF)
8. Utility Nuclear Waste Management Group—Edison Electric Institute (UNWMG–EEI)
9. Natural Resources Defense Council, Inc. (NRDC)
10. Attorney General of the State of Wisconsin (Wis.)
11. U.S. Department of Energy (DOE)
12. American Nuclear Society (ANS)
13. Attorney General of the State of Minnesota (Minn.)

Environmental Impact

This final rule amends 10 CFR Part 51 of the Commission's regulations to incorporate the generic determination made by the Commission at the conclusion of the Waste Confidence rulemaking proceeding that for at least 30 years beyond the expiration of reactor operating licenses no significant environmental impacts will result from the storage of spent fuel in reactor facility storage pools or independent spent fuel storage installations located at reactor or away-from-reactor sites. The detailed environmental analysis on which the generic determination was based can be found in the record at that proceeding published elsewhere in this issue. This rulemaking action formally incorporating the generic determination in the Commission's regulations has no separate independent environmental impact.

The other amendments to Parts 50 and 51 of the Commission's regulations set out in the final rule contain procedures which relate to the submission and review of applications for licenses, license amendments and other forms of permission. The final rule specifies notification procedures applicable to licensee proposals for the management of irradiated fuel following expiration of a reactor operating license and the types of environmental information required to be submitted or addressed in connection with an application for a license or license amendment to store spent fuel at a nuclear power reactor or at an independent spent fuel storage installation after the reactor operating license has expired. Accordingly, these amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(3). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of these amendments.

Paperwork Reduction Act Statement

This final rule amends information collection requirements that are subject to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). These requirements were approved by the Office of Management and Budget (approval numbers 3150–0011 and 3150–0021).

Regulatory Flexibility Certification

As required by the Regulatory Flexibility Act, 5 U.S.C. 605(b), the Commission certifies that this rule does not have a significant economic impact on a substantial number of small entities. This rule affects only the licensing and operation of nuclear power plants. The companies that own these plants are dominant in their service areas and do not fall within the scope of the definition of "small entities" set forth in the Regulatory Flexibility Act or the Small Business Size Standards set out in regulations issued by the Small Business Administration at 13 CFR Part 121.

List of Subjects

10 CFR Part 50

Antitrust, Classified information, Fire prevention, Incorporation by reference, Intergovernmental relations, Nuclear power plants and reactors, Penalty, Radiation protection, Reactor siting criteria, Reporting and record keeping requirements.

10 CFR Part 51

Administrative practice and procedure, Environmental impact statement, Nuclear materials, Nuclear power plants and reactors, Reporting and record keeping requirements.

For the reasons set out in the Preamble and under the authority of the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, and 5 U.S.C. 553, the NRC is adopting the following amendments to 10 CFR Parts 50 and 51.

PART 50—DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

1. The authority citation for Part 50 continues to read as follows:

Authority: Secs. 103, 104, 161, 182, 183, 186, 189, 68 Stat. 936, 937, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 1244, as amended (42 U.S.C. 2133, 2134, 2201, 2232, 2233, 2236, 2239, 2282); secs. 201, 202, 206, 88 Stat. 1242, 1244, 1246, as amended (42 U.S.C. 5841, 5842, 5846), unless otherwise noted.

Section 50.7 also issued under Pub. L. 96–601, sec. 10, 92 Stat. 2951 (42 U.S.C. 5851). Sections 50.57(d), 50.58, 50.91, and 50.92 also issued under Pub. L. 97–415, 96 Stat. 2071, 2073 (42 U.S.C. 2133, 2239). Section 50.78 also issued under sec. 122, 68 Stat. 939 (42 U.S.C. 2152). Sections 50.80–50.81 also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Sections 50.100–50.102 also issued under sec. 186, 68 Stat. 955 (42 U.S.C. 2236).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273), §§ 50.10 (a), (b), and (c), 50.44, 50.46, 50.48, 50.54, and 50.80(a) are issued under sec. 161b, 68 stat. 948, as amended (42 U.S.C. 2201(b)); §§ 50.10 (b) and (c) and 50.54 are issued under sec. 161i, 68 Stat. 949, as amended (42 U.S.C. 2201(i)); and §§ 50.55(e), 50.59(b), 50.70, 50.71, 50.72, 50.73, and 50.78 are issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

2. In § 50.54, a new paragraph (bb) is added to read as follows:

§ 50.54 Conditions of licenses.

Whether stated therein or not, the following shall be deemed conditions in every license issued.

* * * * *

(bb) For operating nuclear power reactors, the licensee shall, no later than 5 years before expiration of the reactor operating license, submit written notification to the Commission for its review and preliminary approval of the program by which the licensee intends to manage and provide funding for the management of all irradiated fuel at the reactor upon expiration of the reactor operating license until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal in a repository. Final Commission review will be undertaken as part of any proceeding for continued licensing under Part 50 or Part 72. The licensee must demonstrate to NRC that the elected actions will be consistent with NRC requirements for licensed possession of irradiated nuclear fuel and that the actions will be implemented on a timely basis. Where implementation of such actions require NRC authorizations, the licensee shall verify in the notification that submittals for such actions have been or will be made to NRC and shall identify them. A copy of the notification shall be retained by the licensee as a record until expiration of the reactor operating license. The licensee shall notify the NRC of any significant changes in the proposed waste management program as described in the initial notification.

PART 51—ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING AND RELATED REGULATORY FUNCTIONS

3. The authority citation for Part 51 continues to read as follows:

Authority: Sec. 161, 68 Stat. 948, as amended (42 U.S.C. 2201), secs. 201, as amended, 202, 88 Stat. 1242, as amended, 1244 (42 U.S.C. 5841, 5842).

Subpart A also issued under National Environmental Policy Act of 1969, secs. 102, 104, 105, 83 Stat. 853–854, as amended (42 U.S.C. 4332, 4334, 4335); and Pub. L. 95–604, Title II, 92 Stat. 3033–3041. Section 51.22 also issued under sec. 274, 73 Stat. 688, as amended by 92 Stat. 3036–3038 (42 U.S.C. 2021).

4. A new § 51.23 is added to read as follows:

§ 51.23 Temporary storage of spent fuel after cessation of reactor operation—Generic determination of no significant environmental impact.

(a) The Commission has made a generic determination that for at least 30 years beyond the expiration of reactor operating licenses no significant environmental impacts will result from the storage of spent fuel in reactor facility storage pools or independent spent fuel storage installations located at reactor or away-from-reactor sites. Further, the Commission believes there is reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the year 2007–2009, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.

(b) Accordingly, as provided in §§ 51.30(b), 51.53, 51.61, 51.80(b), 51.95 and 51.97(a), and within the scope of the generic determination in paragraph (a) of this section, no discussion of any environmental impact of spent fuel storage in reactor facility storage pools or independent spent fuel storage installations (ISFSI) for the period following the term of the reactor operating license or amendment or initial ISFSI license or amendment for which application is made, is required in any environmental report, environmental impact statement, environmental assessment or other analysis prepared in connection with the issuance or amendment of an operating license for a nuclear reactor or in connection with the issuance of an initial license for storage of spent fuel at an ISFSI, or any amendment thereto.

(c) This section does not alter any requirements to consider the environmental impacts of spent fuel storage during the term of a reactor operating license or a license for an ISFSI in a licensing proceeding.

5. In § 51.30, a new paragraph (b) is added to read as follows:

§ 51.30 Environmental assessment.

* * * * *

(b) Unless otherwise determined by the Commission, an environmental assessment will not include discussion of any aspect of the storage of spent fuel within the scope of the generic determination in § 51.23(a) and in accordance with the provisions of § 51.23(b).

6. Section 51.53 is revised to read as follows:

§ 51.53 Supplement to Environmental Report.

(a) *Operating license stage.* Each applicant for a license or for renewal of a license to operate a production or utilization facility covered by § 51.20 shall submit with its application the number of copies, as specified in § 51.55, of a separate document, entitled "Supplement to Applicant's Environmental Report—Operating License Stage," which will update "Applicant's Environmental Report—Construction Permit Stage." Unless the applicant requests the renewal of an operating license or unless otherwise required by the Commission, the applicant for an operating license for a nuclear power reactor shall submit this report only in connection with the first licensing action authorizing full power operation. In this report, the applicant shall discuss the same matters described in §§ 51.45, 51.51 and 51.52, but only to the extent that they differ from those discussed or reflect new information in addition to that discussed in the final environmental impact statement prepared by the Commission in connection with the construction permit. Unless otherwise required by the Commission, no discussion of need for power or alternative energy sources or alternative sites for the facility or of any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b) is required in this report. The "Supplement to Applicant's Environment Report—Operating License Stage" may

incorporate by reference any information contained in the "Applicant's Environmental Report—Construction Permit Stage," final environmental impact statement or record of decision previously prepared in connection with the construction permit.

(b) *Post operating license stage.* Each applicant for a license or license amendment to store spent fuel at a nuclear power reactor after expiration of the operating license for the nuclear power reactor shall submit with its application the number of copies, as specified in § 51.55, of a separate document, entitled "Supplement to Applicant's Environmental Report—Post Operating License Stage." Unless otherwise required by the Commission, in accordance with the generic determination in § 51.23(a) and the provisions in § 51.23(b), the applicant shall only address the environmental impact of spent fuel storage for the term of the license applied for. The "Supplement to Applicant's Environmental Report—Post Operating License Stage" may incorporate by reference any information contained in "Applicant's Environmental Report—Construction Permit Stage," "Supplement to Applicant's Environmental Report—Operating License Stage," final environmental impact statement, supplement to final environmental impact statement or records of decision previously prepared in connection with the construction permit or operating license.

7 Section 51.61 is revised to read as follows:

§ 51.61 Environmental report—Independent spent fuel storage installation (ISFSI) license.

Each applicant for issuance of a license for storage of spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to Part 72 of this chapter shall submit with its application to the Director of Nuclear Material Safety and Safeguards the number of copies, as specified in § 51.66 of a separate document, entitled "Applicant's Environmental Report—ISFSI License." The environmental report shall contain the information specified in § 51.45 and shall address the siting evaluation factors contained in Subpart E of Part 72 of this chapter. Unless otherwise required by the Commission, in accordance with the generic determination in § 51.23(a) and the provisions of § 51.23(b), no discussion of the environmental impact of the storage of spent fuel at an ISFSI beyond the term of the license or amendment applied for is required in an environmental report submitted by an applicant for an initial license for storage of spent fuel in an ISFSI, or any amendment thereto.

8. Section 51.80 is revised to read as follows:

§ 51.80 Draft environmental impact statement—Material license.

(a) The NRC staff will either prepare a draft environmental impact statement or as provided in § 51.92, a supplement to a final environmental impact statement for each type of action identified in § 51.20(b) (7)–(12). Except as the context may otherwise require, procedures and measures similar to those described in §§ 51.70, 51.71, 51.72 and 51.73 will be followed.

(b) *Independent spent fuel storage installation (ISFSI).* Unless otherwise determined by the Commission, and in accordance with the generic determination in § 51.23(a) and the provisions of § 51.23(b), a draft environmental impact statement on the issuance of an initial license for storage of spent fuel at an independent spent fuel storage installation (ISFSI) or any amendment thereto, will address environmental impacts of spent fuel storage only for the term of the license or amendment applied for.

9. Section 51.95 is revised to read as follows:

§ 51.95 Supplement to final environmental impact statement.

(a) *Operating license stage.* In connection with the issuance of an operating license for a production or utilization facility, the NRC staff will prepare a supplement to the final environmental impact statement on the construction permit for that facility, which will update the prior environmental review. The supplement may incorporate by reference any information contained in the final environmental impact statement or in the record of decision prepared in connection with the construction permit for that facility. The supplement will include a request for comments as provided in § 51.73. The supplement will only cover matters which differ from, or which reflect significant new information concerning matters discussed in the final environmental impact statement. Unless otherwise determined by the Commission, a supplement on the operation of a nuclear power reactor will not include discussion of need for power or alternative energy sources or alternative sites or of any aspect of the storage of spent fuel for the nuclear power reactor within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b), and will only be prepared in connection with the first licensing action authorizing full power operation.

(b) *Post operating license stage.* In connection with the issuance, amendment or renewal of a license to store spent fuel at a nuclear power reactor after expiration of the operating license for the nuclear power reactor, the NRC staff will prepare a supplemental environmental impact statement for the post operating license stage or an environmental assessment, as appropriate, which will update the prior environmental review. The supplement or assessment may incorporate by reference any information contained in the final environmental impact statement, the supplement to the final environmental impact statement—operating license stage, or in the records of decision prepared in connection with the construction permit or the operating license for that facility. The supplement will include a request for comments as provided in § 51.73. Unless otherwise required by the Commission, in accordance with the generic determination in § 51.23(a) and the provisions of § 51.23(b), a supplemental environmental impact statement for the post operating licence stage or an environmental assessment as appropriate, will address the environmental impacts of spent fuel storage only for the term of the license, license amendment or license renewal applied for.

10. A new § 51.97 is added to read as follows:

§ 51.97 Final environmental impact statement—Materials license.

(a) *Independent spent fuel storage installation (ISFSI).* Unless otherwise determined by the Commission, and in accordance with the generic determination in § 51.23(a) and the

provisions of § 51.23(b), a final environmental impact statement on the issuance of an initial license for the storage of spent fuel at an independent spent fuel storage installation (ISFSI) or any amendment thereto, will address environmental impacts of spent fuel storage only for the term of the license or amendment applied for.

(b) [Reserved]

Dated at Washington, D.C. this 22nd day of August, 1984.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,

Secretary of the Commission.

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